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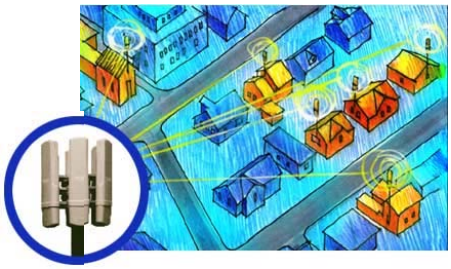

Canopy™ T1/E1 Multiplexer

User Guide

T1E1Mux-UG-en
Issue 3
September 2004

CANOPY™
Motorola Wireless Broadband Platform

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1 UNDERSTANDING THE CANOPY T1/E1 MULTIPLEXER

1.1 USING THIS USER GUIDE

This guide should be used with Canopy T1/E1 Multiplexer FPGA Version 3.4. The audience for this document includes system operators, network administrators, and equipment installers.

1.1.1 New in This Issue

Issue 3 of this user guide is published to state the requirement that an external surge suppression device must be used with the AC adapter supplied by Canopy for the T1/E1 Multiplexer, and to specify the recommended standard. The following elements of this document are affected:

- Introduction to Canopy T1/E1 Multiplexer on Page 9
- beneath Figure 3 on Page 12
- Power Adapters on Page 18
- Lightning Protection on Page 27
- Power Supply Unit on Page 27
- Procedure 3 on Page 31

Also in Issue 3, Preparing for Installation and Setup on Page 28 clarifies how Ethernet cables must be selected.

1.1.2 Using the Latest Information

When Canopy T1/E1 Multiplexers are shipped, the latest issue of this document is included on CD-ROM with the shipment. However, the latest issue at any time is available on the Canopy web site: http://www.motorola.com/canopy, posted among the user guides that support other Canopy products.

You can distinguish the latest information by the issue number on the cover and in page footers. The above section, New in This Issue, lists the significant changes that were made to the document since the previous issue. Check that section before you proceed to the information for which you are visiting the document.

1.1.3 Searching This User Guide

To search this document, look in

- the Table of Contents for the topic.
- the Adobe Reader® search capability for keywords that apply.[1]

1.1.4 Interpreting Typeface and Other Conventions

This document employs distinctive fonts to indicate the type of information, as described in Table 1.

[1] Reader is a registered trademark of Adobe Systems, Incorporated.

Table 1: Font types

Font	Type of Information
variable width bold	Selectable option in a graphical user interface or settable parameter in the web-based interface to a Canopy component.
`constant width regular`	Literal system response in a command-line interface.
`constant width italic`	Variable system response in a command-line interface.
`constant width bold`	Literal user input in a command-line interface.
`constant width bold italic`	Variable user input in a command-line interface.

This document also employs a set of consistently used admonitions. Each of these types of admonitions has a general purpose that underlies the specific information in the box. These purposes are indicated in Table 2.

Table 2: Admonition types

Admonition Label	General Message
	NOTE: informative content that may ◦ defy common or cursory logic. ◦ describe a peculiarity of the Canopy implementation. ◦ add a conditional caveat. ◦ provide a reference. ◦ explain the reason for a preceding statement or provide prerequisite background for what immediately follows.
	RECOMMENDATION: suggestion for an easier, quicker, or safer action or practice.
	IMPORTANT! informative content that may ◦ identify an indication that you should watch for. ◦ advise that your action can disturb something that you may not want disturbed. ◦ reiterate something that you presumably know but should always remember.

Admonition Label	General Message
	CAUTION! a notice that the risk of harm to equipment or service exists.
	WARNING! a notice that the risk of harm to person exists.

1.1.5 Getting Additional Help

Help is available for problems with supported products and features. The sequence of actions that you should take if these problems arise is provided under Obtaining Technical Support on Page 65.

1.1.6 Sending Feedback

We welcome your feedback on Canopy system documentation. This includes feedback on the structure, content, accuracy, or completeness of our documents, and any other comments you have. Please send your comments to technical-documentation@canopywireless.com.

1.2 INTRODUCTION TO CANOPY T1/E1 MULTIPLEXER

This user guide provides the installation and configuration requirements for the Canopy T1/E1 Multiplexer, a modular gateway that works with Canopy Backhaul Modules to enable up to four T1 (or up to three E1) circuits to be extended over Ethernet networks. The Canopy T1/E1 Multiplexer is available in two power configurations:

- an external 3.3-v DC power source from a 120/240-v AC adapter (supplied by Canopy)

WARNING!
An external AC surge suppression device must be used with the Canopy T1/E1 Multiplexer. For infrastructure installations, Canopy Engineering recommends an AC line surge suppression unit that meets the standard IEC 801-5 (EN61000-4-5) Maximum Surge Voltage (1.2x50µsec) 6 KV.

- a connection to an external −48 v DC supply.

The Canopy T1/E1 Multiplexer is illustrated with Canopy Backhaul Modules (BHs) in Figure 1.

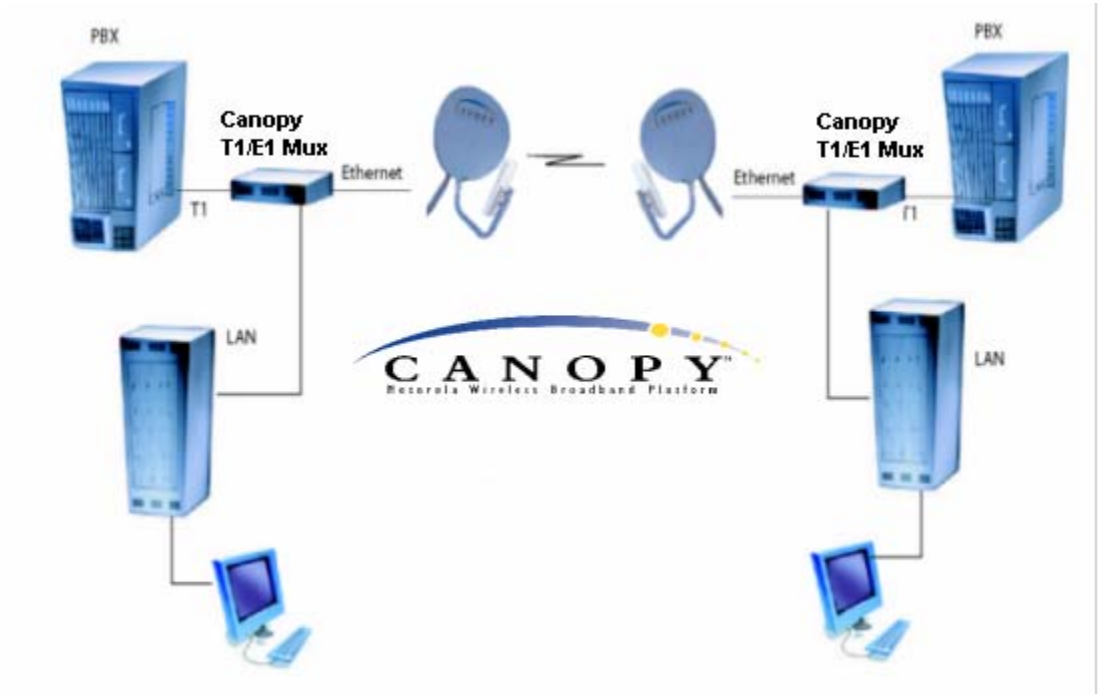

Figure 1: Canopy T1/E1 Multiplexer with Canopy BHs

The T1/E1 Multiplexer converts the data stream from T1/E1 ports into Ethernet packets that are then transported over the Canopy BH link. This device can be used to extend T1/E1 services. You can configure the Canopy T1/E1 Multiplexer to operate as either a T1 or an E1 device.

Applications of the T1/E1 Multiplexer include

- obviating leased lines.
- implementing wireless PBX networking.
- establishing cellular backhaul links.
- providing homeland security backup or emergency voice networks.
- routing LAN/WAN data on excess bandwidth.

1.2.1 Ethernet Interface

The Ethernet physical layer auto-negotiation should be set to *on* for both sides of the Canopy T1/E1 Multiplexer.

RJ-45 connector pin-outs for the Ethernet cable from the BH to the Canopy port of the Canopy T1/E1 Multiplexer are illustrated in Figure 12 on Page 30.

1.2.2 Standards

The Canopy T1/E1 Multiplexer conforms to the following standards:

- G.703
- G.823
- G.824
- ANSI T1.403
- TR-AT&TG2411
- IEEE 802.3
- EMC Class A compliance – EN 55022 Class A

1.2.3 IDU Physical Description

The unit provides a compact, simple to configure, and easily scalable solution for transporting T1/E1 services over Canopy wireless Ethernet-based networks.

1.2.4 Rear Panel

Interface connections and the power port are located on the rear panel of the unit.

Figure 2: Canopy T1/E1 Multiplexer rear panel

Figure 3: Rear panel with standard 110-v source power supply

WARNING!
An external AC surge suppression device must be used with the Canopy T1/E1 Multiplexer. For infrastructure installations, Canopy Engineering recommends an AC line surge suppression unit that meets the standard IEC 801-5 (EN61000-4-5) Maximum Surge Voltage (1.2x50µsec) 6 KV.

Figure 4: Standard adapters for global use

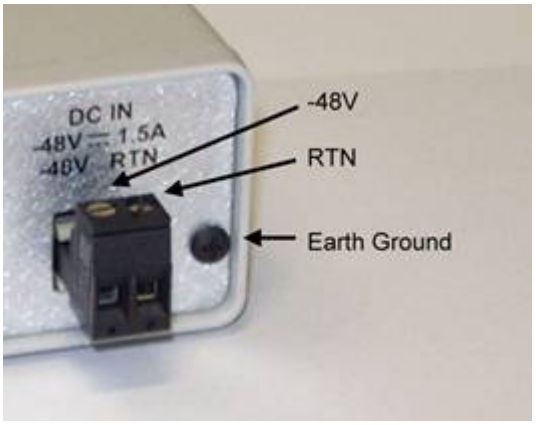

Figure 5: Rear panel with optional −48 v power supply adapter for battery backup

The recommended sequence of connection is:

1. Connect a PBX or TDM CPE to the T1/E1 port(s). (See Figure 2 on Page 11.)
2. Connect the Ethernet cable from the Canopy Backhaul Module to the jack labeled Canopy. (See Figure 2 on Page 11.)
3. Connect the selected power adapter to the T1/E1 Multiplexer. (See Figure 3 and Figure 4.)
4. Power the T1/E1 Multiplexer on. (See Figure 3.)
5. As required to configure the T1/E1 Multiplexer, connect a notebook computer to the jack labeled CONTROL on the front panel of the T1/E1 Multiplexer. (See Figure 6.)

1.2.5 Front Panel

The control port and indicator LEDs are located on the front panel of the unit.

Figure 6: Canopy T1/E1 Multiplexer front panel

Status LEDS

The status indicator LEDS on the front of the Canopy T1/E1 Multiplexer are listed in Table 3.

Table 3: LED status indicator descriptions

LED	LED indicator descriptions
PWR	ON when main power supply is OK; OFF when a malfunction is detected
RDY	ON when self-test is successfully completed; OFF during self-test; and BLINKING when self-test fails
CANOPY LINK	OFF when line is not active; ON when Canopy BH Ethernet line is OK
CANOPY ACT	OFF when no activity; BLINKNG when frames are being transmitted or received on the line
LAN LINK	OFF when line is not active; ON when line is OK

LED	LED indicator descriptions
LAN ACT	OFF when no activity; BLINKING when frames are being transmitted or received on the line
T1/E1 Sync	ON when the port is synchronized (no alarm); OFF when Loss of signal (LOS); one LED for each T1/E1

1.2.6 Features

The Canopy T1/E1 Multiplexer

- installs easily.
- multiplexes up to 4 T1 or 3 E1 circuits onto a Canopy Backhaul point-to-point link.
- enables T1/E1 extension over Ethernet networks.
- supports
  - synchronous TDM-based services over wireless Ethernet networks.
  - CAS signaling transparent to all other signaling protocols on T1/E1.
  - 10Base-T/100Base-TX uplink to the network.
  - management interfaces.
  - simplified troubleshooting through T1/E1 line loopback test.

1.2.7 Specifications

Physical Specifications

Table 4 lists the physical specifications for the Canopy T1/E1 Multiplexer.

Table 4: Canopy T1/E1 Multiplexer physical specifications

Specification	Description
DC Power	Option 1: 100/240 v, 47−63 Hz, 0.4 A (+3.3 v DC)
	Option 2: −48 v DC
LAN Connection	2-100Base-TX, RJ-45 cable provided
T1/E1 Connections	4
Control Port	RS-232, DB9 (female)
Indicators	power, ready, Canopy BH Ethernet link; Canopy BH Ethernet activity; LAN Ethernet link; LAN Ethernet activity; T1/E1 synchronization (one per port)
Temperature	0° C to 40° C
Humidity	95% non-condensing
Dimensions	1.52” (3.86 cm) high x 5.57" (14.15 cm) wide and 7.50" (19.05 cm) deep
Weight	1.5 pounds (680 grams)

Technical Specifications

The following tables list the technical specifications for the Canopy T1/E1 Multiplexer.

Table 5: T1 port specifications

Specification	Description
Ports	1, 2, 3, and 4
Compliance	ANSI T1.403
Connector	RJ-45, 8-pin
T1 Data Rate	1.55 Mbps
T1 Line Code	B8ZS, AMI
Line Impedance	Balanced: 100 ohms
Signal levels	Receive: 0 to -27 dB Transmit: +2.7 v + 10%, adjustable, measured in range 0 to 655 feet.
Jitter Performance	AT&T TR-62411, G.824 Standards

Table 6: T1 framing specifications

Specification	Description
Compliance	ANSI T1.403
Framing	D4, ESF (transparent)
Signaling	CAS (Robbed bit signaling); CCS (transparent)

Table 7: E1 port specifications

Specification	Description
Ports	1, 2, and 3
Compliance	ITU-T G.703
Connector	RJ-45, 8-pin
E1 Data Rate	2.048 Mbps
E1 Line Code	HDB3, AMI
Line Impedance	Balanced: 120 ohms
Signal levels	Receive: Per G.703 Transmit: Per G.703
Jitter Performance	ITU-T G.823

Table 8: E1 framing specifications

Specification	Description
Compliance	ITU-T G.703
Framing	transparent
Signaling	transparent

Table 9: Local terminal and control interface specifications

Specification	Description
Type	RS-232 via DB-9 Female Connector
Mode	DTE
Baud Rate	19.2 kbps

1.3 CONFIGURATION SETTINGS FROM CANOPY FACTORY

1.3.1 Bit Handling Capability

As shipped, Canopy T1/E1 Multiplexers transparently pass all T1 or E1 bits regardless of

- user framing as
  - D4
  - Extended Superframe (ESF)
- user encoding as
  - AMI
  - B8ZS
  - HDB3

However, user encoding is helpful for generating meaningful bipolar variation (BPV) data. Canopy T1/E1 Multiplexers are factory preset to the B8ZS encoding for T1, though easily changed to another encoding scheme, and are preset as master or slave for timing.

NOTE: To receive the highest level of performance from these units, the user should understand

- clock recovery timing.
- packet/frame loss concepts.
- delay and latency.
- jitter.

1.3.2 License Keys

Each Canopy T1/E1 Multiplexer is purchased and shipped as 1-port enabled or 4-port enabled. You can upgrade any pair of 1-port enabled Canopy T1/E1 Multiplexers through the purchase and installation of

- two keys, one per unit, to transform both to 2-port enabled.
- four keys, two per unit, to transform both to 3-port enabled.
- six keys, three per unit, to transform both to 4-port enabled.

1.3.3 Power Adapters

For connection to power sources, the 110-volt power supply pictured in Figure 3 on Page 12 and the global adapter set pictured in Figure 4 on Page 12 are included with the purchase of each Canopy T1/E1 Multiplexer.

WARNING!
An external AC surge suppression device must be used with the Canopy T1/E1 Multiplexer. For infrastructure installations, Canopy Engineering recommends an AC line surge suppression unit that meets the standard IEC 801-5 (EN61000-4-5) Maximum Surge Voltage (1.2x50µsec) 6 KV.

The −48 v screw-down adapter for battery backup pictured in Figure 5 on Page 13 is an option.

1.4 PRODUCT LABELS

Labels on the Canopy T1/E1 Multiplexer include

- ESN — Electronic Serial Number, the Media Access Control (MAC) address
- MSN — Model Serial Number, which allows tracking of the product
- Factory Configuration, which identifies the product as
  - Master Unit or Slave Unit
  - 1-Port Unit or 4-Port Unit

1.5 FUNCTIONAL DESCRIPTION OF THE CANOPY T1/E1 MULTIPLEXER

The Canopy T1/E1 Multiplexer has a LAN Ethernet port, a Canopy Backhaul Module Ethernet port, and four ports as follows:

- up to four available when the unit is configured for the T1 transmission scheme.
- up to three available when the unit is configured for the E1 transmission scheme (to support Canopy BH20 Backhaul link traffic).

Configuration and management are provided using the command line interface (CLI) or EMS GUI.

1.5.1 Channel Modes

T1 Channel Mode

While in T1 mode, the Canopy T1/E1 Multiplexer operates as a DSX-1 interface in a DSU channel mode. There are no user options to change this mode. The DSU channel mode can operate within five line lengths, each providing compensation for the length of the T1 line. The line lengths are:

- 0-133 ft. / 0.6dB
- 134-266 ft. / 1.2dB
- 267-399 ft. / 1.8dB
- 400-533 ft. / 2.4dB
- 534-655 ft. / 3.0dB

E1 Channel Mode

While in E1 mode, the transmit line build-out meets the short haul requirements specified in Recommendation ITU G.703.

1.5.2 Encoding

The Canopy T1/E1 Multiplexer transparently passes all T1/E1 bits, including framing, encoding and zero suppression, through to the far end T1/E1 using the Canopy BH Module Ethernet port.

For T1 mode, no user settings are required for D4 or Extended Superframe (ESF) framing types, or for T1 signaling bits. Both 56-kbps and 64-kbps channels are transparently passed. The user must identify which type of T1 is being used; Alternate Mark Inversion (AMI) or Binary Eight Zero Substitution (B8ZS) in order for the Canopy T1/E1 Multiplexer to properly ascertain bipolar violations (BPV). A bipolar violation is a non-zero signal element in an AMI signal that has the same polarity as the previous non-zero signal element.

For T1 mode, the Canopy T1/E1 Multiplexer supports the following:

- Transparent support of the T1 channel, including
  - D4
  - Extended Superframe (ESF)
  - 56-kbps and 64-kbps channels
  - Zero suppression
- AMI
- B8ZS
- up to four ports

For E1 mode, no user settings are required for framing types or for E1 signaling bits. The user must identify which type of E1 is being used; Alternate Mark Inversion (AMI) or High Density Binary Three Bit Zero Substitution (HDB3) in order for the Canopy T1/E1 Multiplexer to properly ascertain bipolar violations (BPV). A bipolar violation is a non-zero signal element in an AMI signal that has the same polarity as the previous non-zero signal element.

For E1 mode, the Canopy T1/E1 Multiplexer supports the following:

- Transparent support of the E1 channel
- AMI
- HDB3
- up to three ports

Alternate Mark Inversion (AMI)

The template of the DS-1 signal is bipolar. This means that a plus voltage, a zero voltage, and a minus voltage are important to the coding of the signal. The code that is used in T1 is called Alternate Mark Inversion (AMI). The requirement is that if a “1” (or Mark) is coded as a positive voltage, the very next “1” must be coded as a minus voltage or the result will be a bipolar violation (BPV). Another one of the requirements of the coding sequence is that a “1” bit is sent to maintain the timing synchronization. A signal that is sending all “0s” would be a constant zero voltage line. The eventual result would be that the system’s timing would be lost. In order to overcome the potential situation where a string of “0s” causes a loss of the system’s timing, a number of zero suppression techniques have been designed. Common techniques are used to handle zero suppression requirements are:

- 1 in 15 Requirement
- B8ZS.
- HDB3

The Canopy T1/E1 Multiplexer fulfills the role of a transparent T1/E1 extender. As such, it is compatible with either AMI, B8ZS, or HDB3 coding of signals. The endpoints determine which of the zero suppression techniques will be applied to the signal. The Canopy T1/E1 Multiplexer must be set to match the zero suppression settings at the endpoints of the signal.

The 1 in 15 Requirement (AMI)

The 1 in 15 requirement stipulates that no more than 15 “0s” may be sent be for every “1” that is transmitted. The easiest approach is to make every bit 8 a “1” and to use only the lower 7 bits for data transmission. This 7/8 mode yields a rate of 56 kbps instead of the standard DS-0 rate of 64 kbps. This technique also prevents the use of signaling bits since bit 8 is now used for a different purpose.

Configuring the Canopy T1/E1 Multiplexer to AMI accommodates the stipulations for bit handling identified in the 1 in 15 requirement.

Binary Eight Zero Substitution Coding

The limitations imposed by the 1 in 15 requirement led to the development of Binary Eight Zero Substitution (B8ZS) coding. This signal coding technique takes advantage of BPVs in the data stream to be decoded as signal. With B8ZS coding, each block of eight consecutive zeros is replaced with the B8ZS code word. The transmitted bit stream will contain two AMI violations.

The receiver will use these violations for synchronization. The receiver recognizes that the transmitted bit stream containing the two AMI violations is not true data. The B8ZS is the standard for "Clear Channel Capability" and is part of ANSI.T1.403-1989.

High Density Bipolar Order Three Encoding

High Density Bipolar Order 3 Encoding (HDB3) is a bipolar signaling technique that is based on Alternate Mark Inversion (AMI). It inserts bipolar violations (BPVs) whenever there is a string of 4 or more zeros. The "violation" bit has the same polarity as the last 1-bit which was sent using AMI encoding. The receiver removes all "violation" bits.

You may select the coding for the Canopy T1/E1 Multiplexer using either the T1/E1 EMS or the CLI manager.

1.5.3 Signaling

All voice and data channel signaling passes transparently between endpoints through the Canopy T1/E1 Multiplexer.

1.5.4 Timing

T1/E1 circuits are synchronous. This means that the T1/E1 circuits must be synchronized or clocked with each other. Failure to do so may result in frame slips. The consequence for which could be a degradation of quality. The clock for a T1/E1 circuit is normally derived from the incoming T1/E1 signal. T1/E1 circuits are typically connected in a master-slave configuration where the master has more accuracy than the slave. A clock in a telecommunications system or network has a quality level or stratum number assigned to it. This number indicates the clock's quality and position in the timing hierarchy. This position is determined by the clock's stability. The more accurate clocks are listed at the top of the hierarchy. A conventional hierarchy for T1 is defined and is used by Local Exchange Carriers (LECs). This hierarchy is called a (Building Integrated Tuning Supply (BITS) hierarchy and the formal specifications and standards for this hierarchy are given in the ANSI standards T1.101-1999 and T1.105.09-1996.

The highest quality clocks are called Stratum 1 clocks. These clocks have a frequency offset of $1x10^{-11}$ or less. This means that Stratum 1 clocks are accurate to within 1 microsecond over a 24-hour period. Stratum 1 clocks are typically Cesium-beam clocks, but the newer GPS-referenced rubidium clocks have been shown to achieve better than $1x10^{-12}$ frequency offset at any time. The next level of clocks is Stratum 2 clocks. Stratum 2 clocks have a $1x10^{-10}$ frequency offset and are typically used at toll centers. Class 5 Central Offices (COs) use Stratum 3 clocks. Stratum 3 clocks have a frequency offset of $3.7x10^{-7}$. Stratum 3 clocks have less than 255 T1 slips in 24 hours. Stratum 4 clocks have a frequency offset of $3.2x10^{-6}$ and are found at customer premises equipment (CPE) in PBXs, channel banks, and routers. Stratum 4 clocks have no hold-over capability and are used to smooth out jitter and wander and provide a clean clock source for customer data. They accomplish this through clock recovery from higher-order T1 clocks from the Class 5 COs or through an internal clock that is running at Stratum 4.

The Canopy T1/E1 Multiplexer does not have an internal clock. Therefore, it must be set to synchronize to an incoming T1/E1 clock source. Each network node's (PBX, Channel Bank, Router) clock is based on the best available clock source for it. If multiple clocks are available with the same quality, then the source that is the closest, in number of hops, is chosen.

Table 10: Frequency off-set by clock type

Clock Type	Frequency Off-set (accuracy over 24 hours)	Time to First Frame Slip	Application
Stratum 1 Clock	1×10^{-11}	1 every 72 days	Gateway Office
Stratum 2 Clock	1×10^{-10}	1 every 3.5 hours	Toll Center
Stratum 3 Clock	3.7×10^{-7}	1 every 6 minutes or 255 in 24 hours	Central Office
Stratum 4 Clock	3.2×10^{-6}	Up to 1 frame slip every 4 seconds in free-run	Customer Premises Equipment (PBX, Channel Banks, Routers)

The Canopy T1/E1 Multiplexer does not have an internal oscillator. Therefore, the unit must be synchronized to a T1/E1 bit stream in order to accurately pass T1/E1 traffic. The Canopy T1/E1 Multiplexer may be configured to synchronize to a near-end or far-end Canopy T1/E1 Multiplexer.

Master and Secondary Clocks

The clock on each Canopy T1/E1 Multiplexer must be correctly configured to prevent frame slips. Each of the four (4) T1/E1 ports may be configured as the Master clock source or the Secondary clock source. Any port may be set to Master and any port may be set to Secondary, however there may only be one (1) Master and one (1) Secondary clock setting per unit.

Note: If neither the Master or Slave port is active, then the system will start at Port 1 and search in logical order until it finds an active T1/E1 port, at which time it will assume this to be the Master clock source.

Two scenarios are shown below, one scenario with Port 1 set to Master and Port 2 set to Secondary. The second scenario shows Port 1 set to Secondary and Port 3 set to Master.

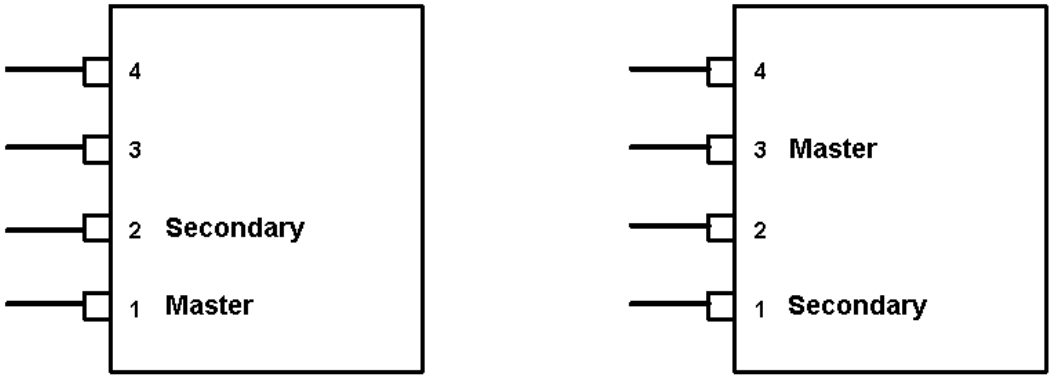

Figure 7: Master and secondary clock settings (top view)

Loss of Clock Signal

Should the Master port not be able to track the incoming T1/E1 bit stream due to a loss of signal, then the unit will use the Secondary port as the clock source. Once the Master T1 recovers synchronization by locking onto the signal, the unit will revert to using the Master port as the clock source.

Timing Modes

Each T1/E1 interface port that is in use must have clocking configured to avoid potential frame slips. All T1/E1 interface ports have an identical global timing mode. There are two timing modes for the Canopy T1/E1 Multiplexer, namely Loopback and Recovery modes.

Loopback mode: the T1/E1 Transmit clock (transmit from the Canopy T1/E1 Multiplexer) is derived from the incoming Receive clock on the T1/E1.

Recovered mode: the T1/E1 Transmit clock (transmit from the Canopy T1/E1 Multiplexer) is derived from the far-end device's transmit clock (the far end Canopy T1/E1 Multiplexer Receive clock). In this mode, a buffer is used to accommodate bursts of Ethernet traffic. The buffer is, on average, maintained at a constant level. As the buffer fills, the Transmit clock increases in frequency to avoid overflow. As the buffer empties, the Transmit clock decreases in frequency in order to maintain a constant level.

Note: when the system is set to Recovered Timing Mode, the derived clock is susceptible to Packet Delay Variation (PDV) and may not comply with jitter and wander specifications.

Loopback Timing Mode

Loopback Timing Mode takes the incoming Transmit clock from a network device, such as a PBX, and derives the clock signal from that device for the outgoing Receive clock (PBX receive clock).

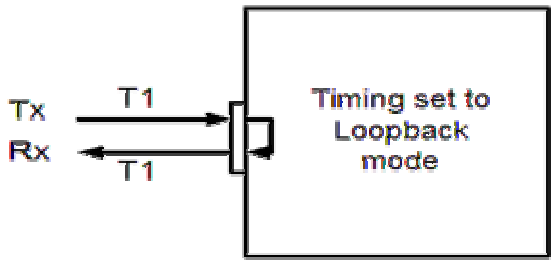

Figure 8: Master timing set to Loopback mode

Recovered Timing Mode

Recovered Timing Mode takes the incoming Ethernet bit stream from the BH link and derives the clock signal from the incoming bit stream for the outgoing Receive clock (PBX receive clock).

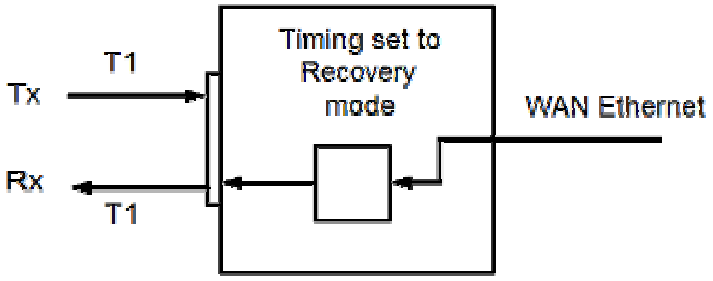

Figure 9: Slave timing set to Recovered mode

Network Timing Scenarios

Typically, when connecting two T1 devices, one end is set as the master clock source and the other end is set as the slave clock source. The slave device takes the timing information from the master clock source. The slave device then synchronizes its clocks with the master. This is shown in Figure 10.

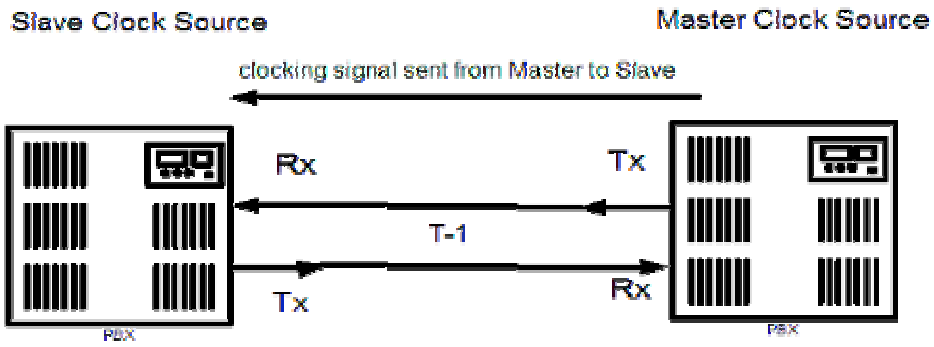

Figure 10: Network timing scenarios

When a Canopy T1/E1 Multiplexer is inserted between two T1 devices, the clocking should be configured in the same manner as it would be without the Canopy T1/E1 Multiplexer. For example, when the Canopy T1/E1 Multiplexer is inserted between the two PBXs, the one PBX will remain as the master clock source and the other PBX will remain as the slave clock source. The Canopy T1/E1 Multiplexer should be configured in the following manner:

- The Canopy T1/E1 Multiplexer connected to the master clock source should be configured in Loopback Timing Mode. The unit will take the clock signal from the PBX master clock source on the PBX transmit side, derive the clock and then send it back to the PBX on the receive side.
- The Canopy T1/E1 Multiplexer connected to the slave clock source should be configured in Recovery Timing Mode. It will derive a clock signal from the incoming bit stream from the WAN side and pass it on to the slave PBX.

In a scenario where T1/E1 devices are configured with an external master clock source, each Canopy T1/E1 Multiplexer should be configured in Loopback Timing Mode. Each Canopy T1/E1 Multiplexer will take the timing signal from the incoming T1/E1, derive the clock and then return the clock to the T1/E1 device. The external clock source may be obtained from any number of sources including Carrier services, GPS, or other high-quality clock source.

For example, each of the two PBXs might have a SONET connection from the local telephone company operator. This connection would be used as the master clock source for both PBXs. Alternatively, each PBX could have a Stratum 3 clock source from the same Central Office, or could be connected to GPS receivers.

1.5.5 Ethernet Throughput

The Ethernet port to the Canopy BH module is a 100-Mbps full duplex port, transmitting at a throughput rate that does not cause buffer overload in the Canopy modules. The LAN side Ethernet port, connected to the customer LAN, also transmits at 100 Mbps full duplex. The Canopy T1/E1 Multiplexer will insert T1/E1 traffic into the Ethernet bit stream and therefore the Ethernet throughput will be reduced by approximately 2 Mbps for each T1/E1 that is programmed.

The rates for Ethernet throughput for each programmed T1/E1 connection are displayed in Table 11.

Table 11: Canopy BH20 Ethernet throughput for programmed T1/E1 connections

Active T1/E1 Channels	Ethernet Half-duplex Throughput on LAN Port in T1 mode.	Ethernet Half-duplex Throughput on LAN Port in E1 mode.
1	5.4 Mbps	5.4 Mbps
2	4.1 Mbps	2.66 Mbps
3	2.34 Mbps	24 Kbps
4	240 Kbps	N/A*

*** Due to the bandwidth limitations of the Canopy BH, only 3 E1 channels can be used.**

NOTE:
The maximum packet rate in T1 mode is 666 packets/sec. The maximum packet rate in E1 mode is 442 packets/sec. Maximum Ethernet rate occurs when using 1518-byte packet streams.

1.5.6 VLAN Support

The Canopy T1/E1 Multiplexer fully supports customer VLAN traffic. The Canopy T1/E1 Multiplexer has an increased maximum Ethernet packet size of 1600 bytes. Typically, the maximum packet size is 1518 bytes for Ethernet traffic, however VLAN traffic adds an extra 4 bytes for the VLAN tag as in the 802.1Q protocol. In addition, some manufacturers, such as Cisco, have proprietary VLAN applications that result in extra long Ethernet packets.

1.5.7 Round-Trip Packet Delay

The one-directional delay between the two T1/E1 endpoints would be approximately 20 milliseconds. This delay does not include any delay added by Canopy Backhaul Modules. The Ethernet throughput delay is the time required for one Ethernet packet to pass through the LAN port of the Canopy T1/E1 Multiplexer. The maximum one-directional delay for an Ethernet packet of size 1518 Bytes is approximately 240 microseconds, excluding the delay that Canopy BH modules introduce.

1.5.8 Alarms

The Canopy T1/E1 Multiplexer supports the Alarm Indication Signal (AIS). It is sent under 2 conditions: a loss of incoming T1/E1 signal (in which case AIS is sent out to the far end and the same for the other end losing T1/E1 signal) and a loss of BH link (in which case the AIS is sent in both directions).

2 INSTALLING AND CONFIGURING YOUR CANOPY T1/E1 MULTIPLEXERS

2.1 SAFETY INFORMATION

2.1.1 Compliance

It is the responsibility of the installer to be sure that all building and safety codes are met and that the installation is complete and secure.

For Canadian installations, the entire equipment installation must comply with Canadian Standard CSA 22.2, No. 60950, Safety of Information Technology Equipment. For installations in the United States, the entire equipment installation must be in accordance with Article 810 of the United States National Electrical Code.

2.1.2 Lightning Protection

When installed, this equipment is to be connected to a Lightning/Surge Protection Device that meets all applicable national safety requirements. See Power Supply Unit on Page 27.

2.1.3 Electrocution Hazard

WARNING!
Electrocution Hazard

This product is intended to be connected to either a 3.3-v DC power source (supplied by Canopy) or an external −48 v DC supply, which must be electrically isolated from any AC sources and reliably connected to ground (Protective Earth). Do not install Canopy products near any type of power line. If any related hardware contacts a power line, severe bodily harm or death could result!

2.1.4 Power Supply Unit

WARNING!
An external AC surge suppression device must be used with the Canopy T1/E1 Multiplexer. For infrastructure installations, Canopy Engineering recommends an AC line surge suppression unit that meets the standard IEC 801-5 (EN61000-4-5) Maximum Surge Voltage (1.2x50µsec) 6 KV.

WARNING!
Substitution of the power supply may impair intrinsic safety. The Canopy T1/E1 Multiplexer must be used with Model Number TR10R033 manufactured by Cincon Electronics Co., Ltd.

2.2 INSTALLATION PROCEDURES

2.2.1 Package Contents

Verify the contents shipped against the packing list for the box. You should have received the following:

- T1/E1 unit
- AC Power supply (Option 1 only)
- CD ROM (EMS GUI and the software download application)

2.2.2 Preparing for Installation and Setup

Select the appropriate type of cable for connection to the Ethernet port of the Canopy T1/E1 Multiplexer as follows:

- For connection to a LAN or a switch, a straight-through cable is required.
- For connection to the NIC card in a PC, a crossover cable is required.
- For connection to a PBX, a T1/E1 crossover cable is *likely* required. Refer to your PBX installation instruction manual for specific requirements.

2.2.3 Mounting the Canopy T1/E1 Multiplexer

Mounting option for the unit is either a desk mount or a rack mount. Follow this procedure to affix the until to a rack mount:

Procedure 1: Affixing the Multiplexer to a rack mount

Remove the Front Panel by removing Front Panel Mounting Screws.

1. Remove the two screw posts from the DB-9 connector.
2. Remove Front Bezel and set aside.

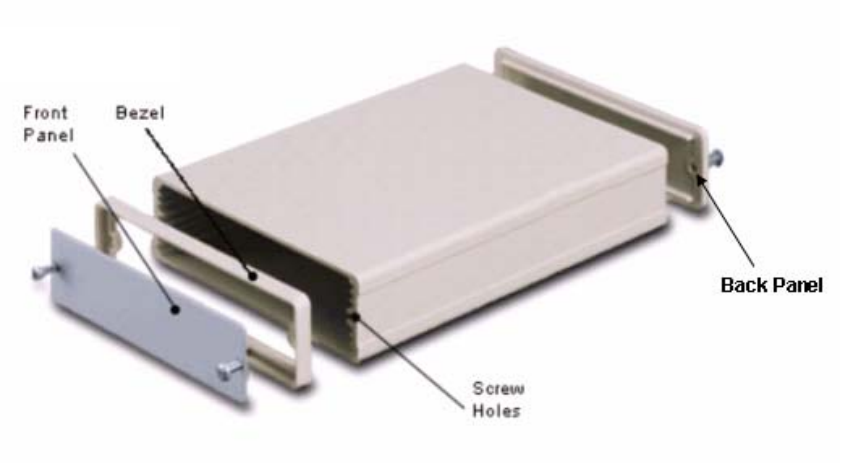

Figure 11: Front panel and front bezel removed

3. Place the Canopy T1/E1 Multiplexer behind the desired Rack Panel mounting hole.
   NOTE: The Rack Panel will support three (3) Canopy T1/E1 Multiplexers.
4. Place the Front Panel on the front of the Rack Panel opening, positioning the Rack Panel Spacer between the two panels.
5. Insert the front panel mounting screws through the screw holes.
6. Tighten screws.
7. Insert the screw posts onto the DB-9 connector.
8. Tighten screw posts.
9. Mount the Canopy T1/E1 Multiplexer with the rack panel onto your rack unit. Consult the product information supplied by the rack manufacturer for details.
   NOTE: The front panel mounting screws should be 4-40 screws, between 3/8" and 5/8" long.

end of procedure

2.2.4 Connecting the Canopy T1/E1 Multiplexer

Table 12: T1/E1 port connector pin-out

Pin	Designation	Direction	Function
1	RD(R)	Input	Receive data (ring)
2	RD(T)	Input	Receive data (tip)
3	FGND		
4	TD(R)	Output	Transmit data (ring)
5	TD(T)	Output	Transmit data (tip)
6	FGND		
7, 8	FGND	Not connected	

Canopy BH RJ-45 connector	Pin	LAN RJ-45 connector	Color
TD+	1	TD+	White/Green
TD-	2	TD-	Green
RD+	3	RD+	White/Orange
Nc	4	Not used	Blue
Nc	5	Not used	White/blue
RD	6	RD	Orange
Nc	7	Not used	White/brown
Nc	8	Not used	brown

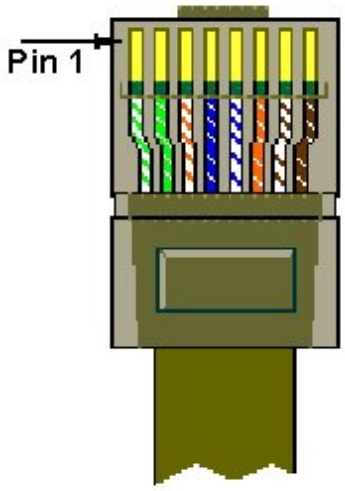

Figure 12: RJ-45 Ethernet connection pin-outs (LAN side)

Perform this procedure to connect the cables to the T1/E1 unit.

Procedure 2: Connecting cables to T1/E1 unit

1. Connect the T1/E1 cables to the T1/E1 ports.
   NOTE: There is a one-to-one relationship between the T1/E1 ports on the Canopy T1/E1 Multiplexer. This means, that the T1/E1 cable connected to the T1/E1 Port 1 on one of the Canopy T1/E1 Multiplexers, must also be connected to Port 1 on the other.
2. Connect the Ethernet cables to the Ethernet ports.
3. Connect the power cable to the power connector.

========== **end of procedure** ==========

2.2.5 Connecting Power to the Canopy T1/E1 Multiplexer

The Canopy T1/E1 Multiplexer is available in two power configurations:

- an external 3.3-v DC power source (supplied by Canopy)
- an external −48 v DC power supply with a terminal strip that plugs into the back of the Canopy T1/E1 Multiplexer.

WARNING!
Disconnect power before proceeding.

Follow this procedure to connect the supplied AC adapter (+3.3 v DC power source).

Procedure 3: Connecting the AC adapter (+3.3 v DC power source)

1. Connect the AC adapter to a surge suppression device that meets the standard specified under Power Supply Unit on Page 27.
2. Connect the surge suppression device to the building AC power source.
3. Connect the AC adapter to the DC IN port on the rear of the Canopy T1/E1 Multiplexer.

end of procedure

Follow this procedure to connect the to an external −48 v DC power source.

Procedure 4: Connecting the −48 v DC power source

CAUTION!
Ensure correct polarity before connecting external DC supply to Canopy T1/E1 Multiplexer.

1. Connect the power cables to the terminal strip ensuring the correct polarity is maintained.
2. Once the Canopy T1/E1 Multiplexer is mounted in its desired configuration, connect the supplied terminal strip to the back of the unit. Do this by slowly pushing the terminal strip into the connector on the back of the Canopy T1/E1 Multiplexer.

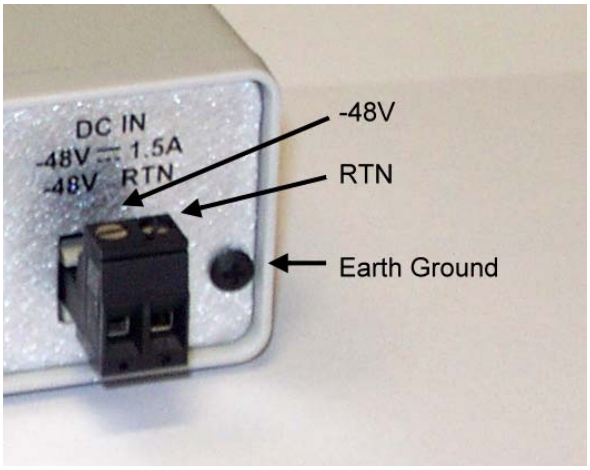

Figure 13: Rear panel Option 2: −48 v DC polarity

3. Connect the power cables to an external −48 v DC supply.

end of procedure

2.3 INITIAL CONFIGURATION PROCEDURES

2.3.1 Installing Software from the CD-ROM

Procedure 5: Installing Software from the CD-ROM

Follow these steps to install the software that is provided by Motorola Canopy on the CD-ROM onto your PC.

1. Load software onto your PC.
   The T1/E1 Multiplexer EMS Graphical User Interface is provided by Canopy on a CD-ROM that is shipped with the unit.
2. Install the software from the CD-ROM by double-clicking the setup application or
3. Issue the **Start->Run->d:/setup** sequence
   where d: is the drive letter of your CD-ROM. If you are using a different drive letter, simply substitute the appropriate drive letter.

end of procedure

2.3.2 Using EMS Software to Configure the Unit

An intuitive graphic unit interface (GUI) provides a user-friendly graphical display that allows easy-to-follow steps to configure the unit. Fault isolation, statistics and events gathering are available. The GUI simplifies field installation.

Examples of drop-down menus are provided in Figure 14 and Figure 15.

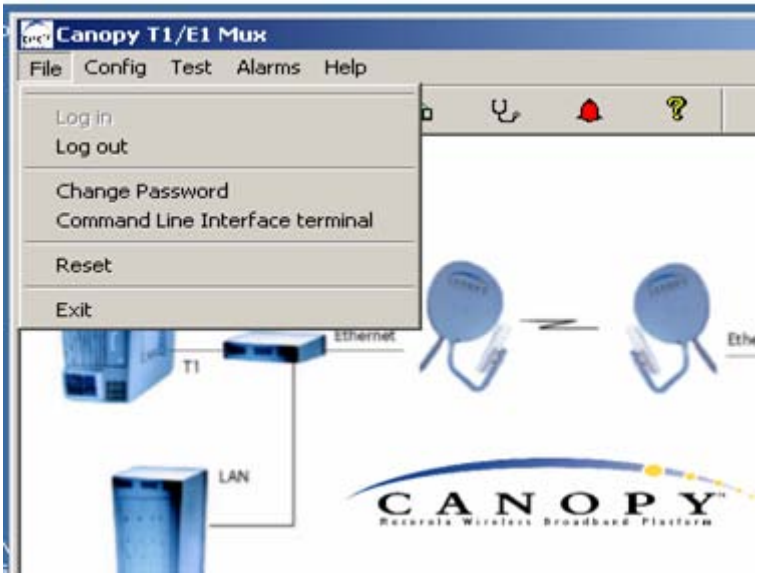

Figure 14: File drop-down menu in GUI

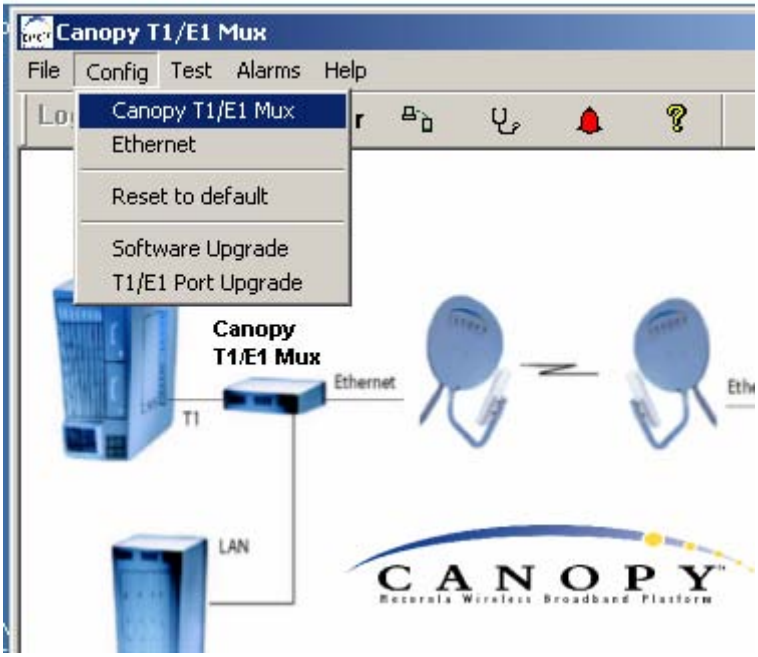

Figure 15: Config drop-down menu in GUI

2.3.3 Accessing the CLI using a PC + HyperTerminal

The Command Line Interface (CLI) is accessed using a PC with that includes a terminal emulation package such as HyperTerminal®.

NOTE: The device is only accessible through the serial port.

2.3.4 Configuring the Canopy T1/E1 Multiplexer using the CLI

Before you use the CLI to configure the Canopy T1/E1 Multiplexer, you must configure the PC serial port.

Procedure 6: Configuring serial port

Use this procedure to access the CLI using a terminal emulation program such as HyperTerminal.®

1. Connect the serial cable from the DB9 serial port on a PC to the Serial port on the Canopy T1/E1 Multiplexer. The DB9 connector on Canopy T1/E1 Multiplexer is female; the cable from the PC is male. A straight-through cable is required.
2. Start HyperTerminal or another terminal emulation program.
3. Set the terminal emulation program to emulate a VT100 terminal with the following settings:

Parameter	Value
Bits per second	19200
Data bits	8
Parity	none
Stop bits	1
Flow control	none

4. Press Enter.
   The Canopy T1/E1 Multiplexer Login menu is displayed.
   RESULT: The signal port is configured.

========== **end of procedure** ==========

To use the CLI, select **Command Line Interface terminal** from the File drop-down menu (illustrated in Figure 14 on Page 33). The Command Line Interface window opens, as shown in Figure 16.

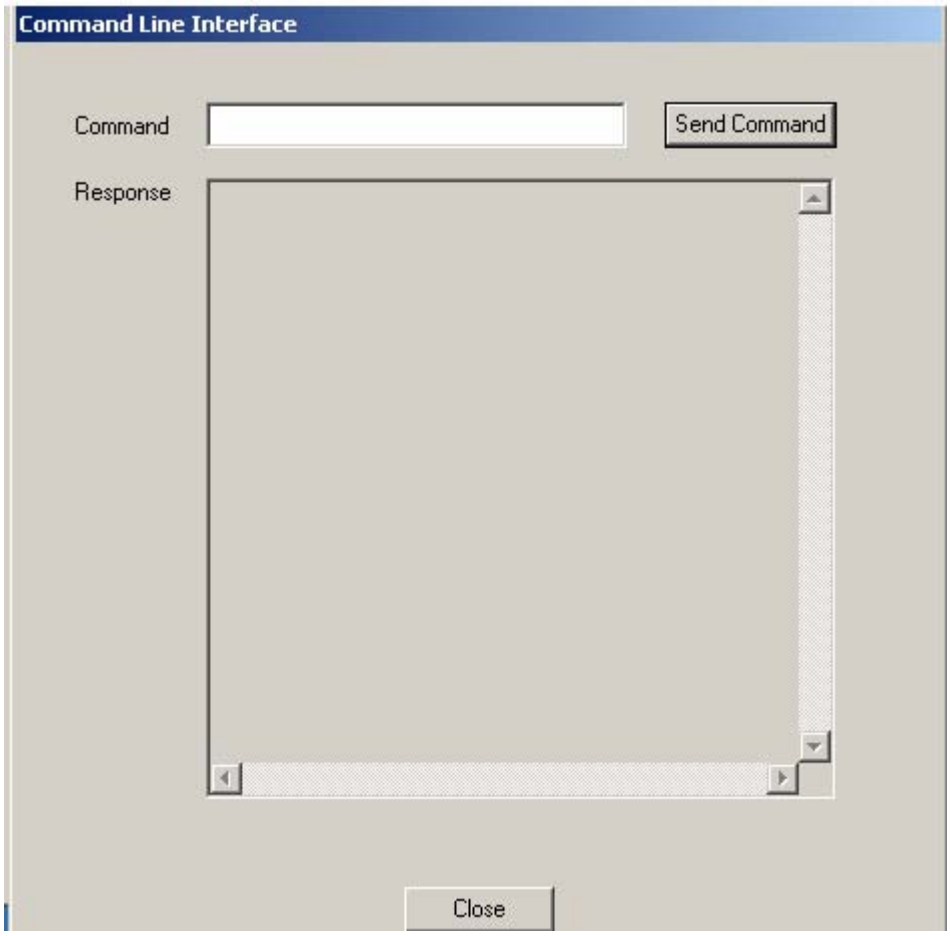

Figure 16: Command Line Interface window

2.3.5 Creating a Login Account

The system is shipped with default setting for the Administrator account. The account is active, but it is recommended you change the password for this account.

NOTE:
The default administrator account username is **admin**.
The default administrator account password is **123**.
You *cannot* change the username. However, you can change the password at any time. If you forget your password, reset the system back to the default account and password by logging in, using the safety account.

The safety account username is **safety**.
The safety account password is **SAFE_qwe**.

When you log in using this account, the password for the administrator account is reset to **123**.The system will then log you out, at which point you may log in using the default administrator account username and password.

2.4 CONFIGURATION PROCEDURES USING THE CLI

2.4.1 Logging into the System

To gain access to the CLI, log into the system as described under Configuration Procedures Using the EMS.

2.4.2 Changing the Administrator Password

Procedure 7: Changing Administrator password using the CLI

Use this procedure to use the CLI manager to change the Administrator account password.

1. Press Enter.
2. At the `username` prompt, enter **`admin.`**
3. At the password prompt, enter **`123`**.
4. Enter change password.
5. At the prompt `Enter your old password: Password:`, enter your old password.
6. At the prompt `Enter your new password: Password:`, enter your new password.
7. At the prompt `Enter your new password: Password:`, re-enter your new password.
   RESULT: The system responds: `Password has been changed.`
8. To log off, enter **`lo`**.
9. Press Enter.

10. At the `username` prompt, enter **`admin`.**
11. At the password prompt, enter your new password.

end of procedure

2.4.3 Select Line Type T1 or E1

Procedure 8: Selecting line type T1 or E1 using the CLI

Follow this procedure to select the appropriate line type using the CLI manager.

Action	Steps
Log in	Press Enter. At the `username` prompt, enter **`admin`.** At the password prompt, enter ***`password`***.
Get line type	Enter **`get line type`**. ***RESULT:*** The system returns the line type for all four ports, as in the following example: `Line type  [T1/E1]`
Set line type	Enter **`set line type [T1/E1]`** where `T1` sets the line type to T1 for all 4 ports. `E1` sets the line type to E1 for all 4 ports. **RESULT:** The system acknowledges the new setting for line type for all four ports, as in the following example: `Line type [T1/E1]`
Reset system	Enter **`reset`**. ***RESULT:*** The system responds `Resetting`, then immediately resets both Ethernet Interfaces and all 4 T1/E1 interfaces without asking for a confirmation. ***CAUTION!*** The previously configured line type remains in effect until the system is reset. Therefore, this step should always be followed by a reset.

end of procedure

2.4.4 Select Line Coding

Procedure 9: Configuring line coding using the CLI

Follow this procedure to select the appropriate line code using the CLI manager.

Action	Steps
Log in	Press Enter. At the `username` prompt, enter **`admin.`** At the password prompt, enter ***`password`***.
Set line code	Enter **`set line [1/2/3/4] code [HDB3/B8ZS/AMI]`** where `HDB3` sets the line type to HDB3 for all 4 E1 ports `B8ZS` sets the line type to B8ZS for all 4 T1 ports. `AMI` sets the line type to AMI for all 4 E1 or T1 ports. ***RESULT:*** The system selects the line code for all four ports, as in the following example. `Line code [1/2/3/4] set to [HDB3/B8ZS/AMI]`
Get line code	Enter **`get line code`**. ***RESULT:*** The system returns the line code for all four ports, as in the following example. `Line code [1/2/3/4] set to [HDB3/B8ZS/AMI]`

========== **end of procedure** ==========

2.4.5 Configure Ports

Procedure 10: Configuring the Ethernet ports using the CLI

Perform this procedure to configure the Ethernet ports using the CLI manager.

NOTE: Both Ethernet ports operate at 100 Mbps Full Duplex. They will not operate at 10 Mbps or at half duplex.

Action	Steps
Log in	Press Enter. At the `username` prompt, enter **`admin.`** At the password prompt, enter ***`password`***.
Set BH-side Ethernet auto-negotiation	Enter **`set canopy port auto negotiation [on/off]`** where `on` enables auto negotiation at 100 Mbps Full Duplex (as default). `off` forces the port to 100 Mbps Full Duplex without auto negotiation. ***RESULT:*** The system responds `Canopy port auto-negotiation is: on`
Set LAN-side Ethernet auto-negotiation	Enter **`set lan port auto negotiation [on/off]`** where `on` enables auto negotiation at 100 Mbps Full Duplex (as default). `off` forces the port to 100 Mbps Full Duplex without auto negotiation. ***RESULT:*** The system responds `LAN port auto-negotiation is: on`
Log off	Enter **`lo`**. ***RESULT:*** The system responds `goodbye`.

end of procedure

Procedure 11: Configuring the T1 ports using the CLI

Follow this procedure to configure the T1 ports from the CLI manager.

Action	Steps
Log in	Press Enter. At the `username` prompt, enter **`admin.`** At the password prompt, enter ***`password`***.
Set T1 line length	***NOTE:*** If the incorrect line length is selected, the result could be decreased T1 quality or echo on voice lines. The default length is 133 ft. Enter **`set line [1/2/3/4] length [133, 266, 399, 533]`** where `[1/2/3/4]` represents T1 ports 1 through 4. `[133, 266, 399, 533, 655]` represents line length in feet. ***RESULT:*** The system responds `Line [1/2/3/4] length [0-133 / 0.6 dB; 133-266 / 1.2 dB; 266-399 / 1.8 dB; 399-533 / 2.4 dB; 533-655 / 3.0 dB]`
Set T1 line code	***NOTE:*** If the line code does not match the incoming T1 settings, then Bipolar Violations (BPVs) will occur. The default code is B8ZS. Enter set line [1/2/3/4] code [B8ZS/AMI] where `[1/2/3/4]` represents T1 ports 1 through 4. `[B8ZS/AMI]` represents the line coding scheme. ***RESULT:*** The system responds `Line [1/2/3/4] code [B8ZS/AMI]`

Action	Steps
Set timing mode	***NOTE:*** Timing mode applies to all four T1 lines. Loopback mode loops the T1/E1 Tx clock to the T1/E1 Rx. Recovered mode recovers the T1/E1 clock from the incoming T1/E1 over Ethernet bit stream (recovers the clock from the far end T1/E1). The default timing mode is Recovered. Enter **`set clock source [loopback/recovered]`** where `[loopback/recovered]` represents the clock timing mode. ***RESULT:*** The system responds `Clock source is [loopback/recovered]`
Set master clock reference line	***NOTE:*** This is the master clock reference for all four T1/E1 lines. The default setting is T1/E1 Port 1. Enter **`set master clock reference line [1/2/3/4]`** where `[1/2/3/4]` represents T1/E1 ports 1 through 4. ***RESULT:*** The system responds `Clk ref line; [1,2,3,4]`
Set backup clock reference line	***NOTE:*** This is the optional backup clock reference for all four T1/E1 lines. The backup clock reference becomes active only when the master clock reference line is unavailable. The default setting is T1/E1 Port 2. Enter **`set secondary clock reference line [1/2/3/4]`** where `[1/2/3/4]` represents T1/E1 ports 1 through 4. ***RESULT:*** The system responds `Backup clk ref line; [1/2/3/4]`
Log off	Enter **`lo`**. ***RESULT:*** The system responds `goodbye`.

========== **end of procedure** ==========

Procedure 12: Configuring the E1 ports using the CLI

Follow this procedure to configure the E1 ports from the CLI manager.

Action	Steps
Log in	Press Enter. At the `username` prompt, enter **`admin.`** At the password prompt, enter ***`password`***.
Set E1 line length	***NOTE:*** If the incorrect line length is selected, the result could be decreased E1 quality or echo on voice lines. The default length is 133 ft. Enter **`set line [1/2/3/4] length [133, 266, 399, 533]`** where `[1/2/3/4]` represents E1 ports 1 through 4. `[133, 266, 399, 533, 655]` represents line length in feet. ***RESULT:*** The system responds `Line [1/2/3/4] length [0-133 / 0.6 dB; 133-266 / 1.2 dB; 266-399 / 1.8 dB; 399-533 / 2.4 dB; 533-655 / 3.0 dB]`
Set E1 line code	***NOTE:*** If the line code does not match the incoming E1 settings, then Bipolar Violations (BPVs) will occur. The default code is HDB3. Enter **`set line [1/2/3/4] code [HDB3/AMI]`** where `[1/2/3/4]` represents E1 ports 1 through 4. `[HDB3/AMI]` represents the line coding scheme. ***RESULT:*** The system responds `Line [1/2/3/4] code [HDB3/AMI]`

Action	Steps

Set timing mode	***NOTE:*** Timing mode applies to all four E1 lines. Loopback mode loops the T1/E1 Tx clock to the T1/E1 Rx. Recovered mode recovers the T1/E1 clock from the incoming T1/E1 over Ethernet bit stream (recovers the clock from the far end T1/E1). The default timing mode is Recovered.
	
	For master clock timing mode, enter
	`set clock source loopback`
	RESULT: The system responds
	`Clock source is loopback`
	
	For slave clock timing mode, enter
	`set clock source recovered`
	RESULT: The system responds
	`Clock source is recovered`

Set master clock reference line	***NOTE:*** This is the master clock reference for all four T1/E1 lines. The default setting is T1/E1 Port 1. Enter **`set master clock reference line [1/2/3/4]`** where `[1/2/3/4]` represents T1/E1 ports 1 through 4. ***RESULT:*** The system responds `Clk ref line; [1,2,3,4]`
Set backup clock reference line	***NOTE:*** This is the backup clock reference for all four T1/E1 lines. The backup clock reference becomes active only when the master clock reference line is unavailable. The default setting is T1/E1 Port 2. Enter **`set secondary clock reference line [1/2/3/4]`** where `[1/2/3/4]` represents T1/E1 ports 1 through 4. ***RESULT:*** The system responds `Backup clk ref line; [1/2/3/4]`
Log off	Enter **`lo`**. ***RESULT:*** The system responds `goodbye`.

========== **end of procedure** ==========

2.4.6 Configure Timing

Before the timing may be configured, you need to determine the network timing scheme to be used. You also need to identify the master and slave devices for the end-user PBX equipment.

Procedure 13: Configuring timing using the CLI

Action	Steps
Log in	Press Enter. At the `username` prompt, enter **`admin.`** At the password prompt, enter ***`password`***.
Set master clock reference line	***NOTE:*** This is the master clock reference for all four T1/E1 lines. The default setting is T1/E1 Port 1. Enter set master clock reference line [1/2/3/4] where `[1/2/3/4]` represents T1/E1 ports 1 through 4. ***RESULT:*** The system responds `Clk ref line; [1,2,3,4]`
Set backup clock reference line	***NOTE:*** This is the optional backup clock reference for all four T1/E1 lines. The backup clock reference becomes active only when the master clock reference line is unavailable. The default setting is T1/E1 Port 2. Enter **`set secondary clock reference line [1/2/3/4]`** where `[1/2/3/4]` represents T1/E1 ports 1 through 4. ***RESULT:*** The system responds `Backup clk ref line; [1/2/3/4]`

Action	Steps

Set timing mode	***NOTE:*** Timing mode applies to all four E1 lines. Loopback mode loops the T1/E1 Tx clock to the T1/E1 Rx. Recovered mode recovers the T1/E1 clock from the incoming T1/E1 over Ethernet bit stream (recovers the clock from the far end T1/E1). The default timing mode is Recovered.
	
	For master clock timing mode, enter
	`set clock source loopback`
	RESULT: The system responds
	`Clock source is loopback`
	
	For slave clock timing mode, enter
	`set clock source recovered`
	RESULT: The system responds
	`Clock source is recovered`

Log off	Enter **`lo`**. ***RESULT:*** The system responds `goodbye`.

========== **end of procedure**==========

2.5 CONFIGURATION PROCEDURES USING THE EMS

2.5.1 Logging into the System

Procedure 14: Logging in using the EMS

If you are using the EMS to access the system, follow the steps below to log in:

1. Select the proper **COM Port** for your PC.
   NOTE: COM1 through COM4 are supported.
2. Enter the **User Name**.
   NOTE: The default username is **`admin`**. This value cannot be changed.
3. Enter the **Password**.
   NOTE: The default password is **`123`**. If the password has been changed, enter the correct password.
4. Select the **Login** button to continue with the login.
   NOTE: If the login is unsuccessful, the system will generate a pop-up error window. You may return to the Login window to correct the data.

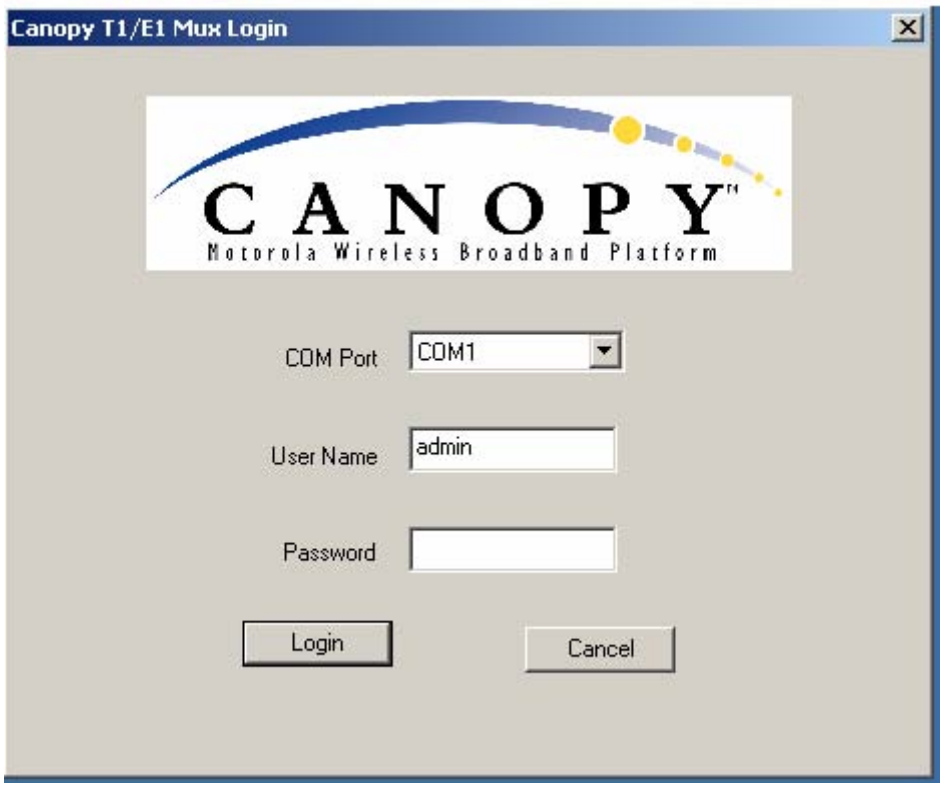

Figure 17: Login dialogue box

Once you are successfully logged in, the T1/E1 Multiplexer EMS Main Menu opens (shown in Figure 18).

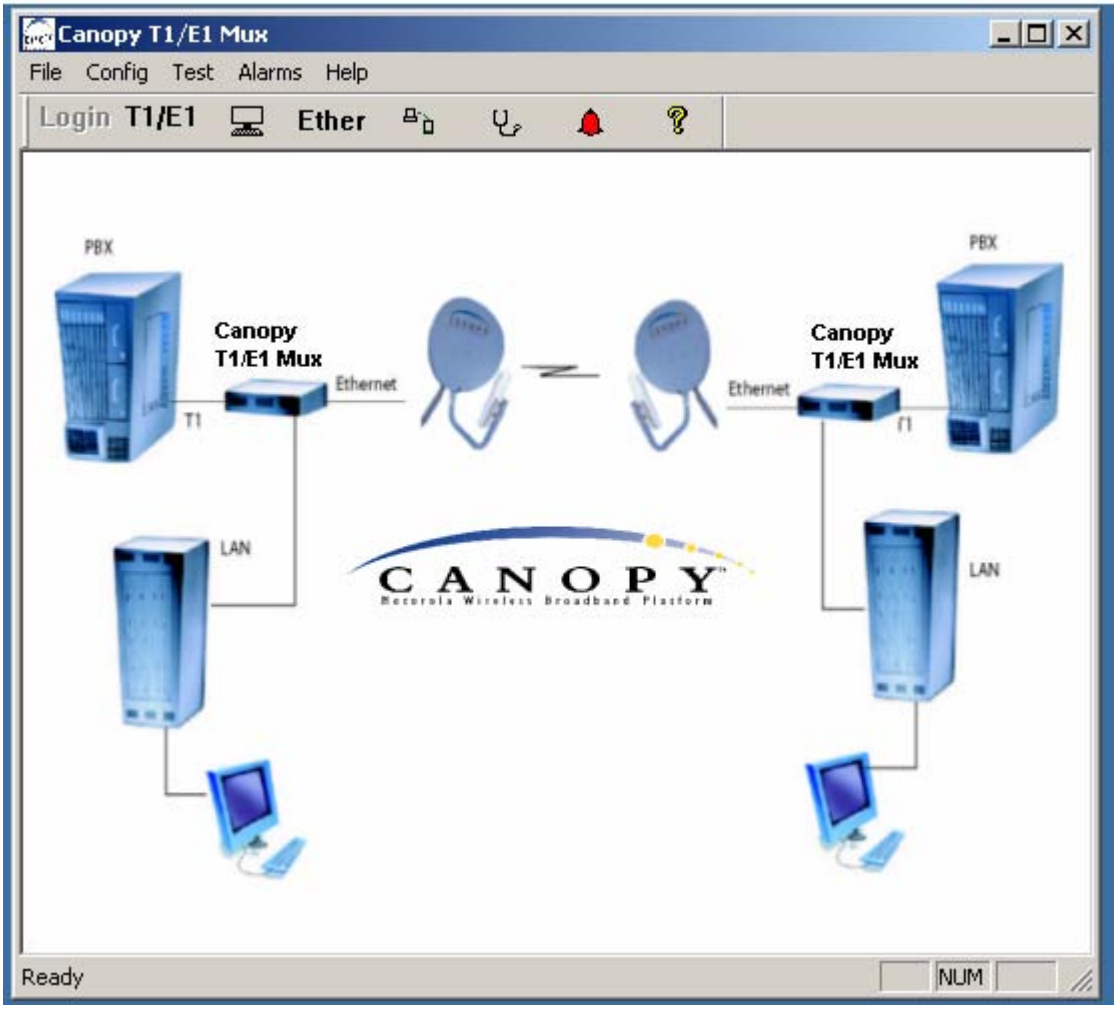

Figure 18: T1/E1 Multiplexer EMS main menu

========== **end of procedure** ==========

NOTE:
You can access CLI commands by selecting **File→Command Line Terminal** from the EMS Main menu.

2.5.2 Changing the Administrator Password

There is only one account for the Canopy T1/E1 Multiplexer—the administrator account. The username may not be changed, however the password may be changed at any time.

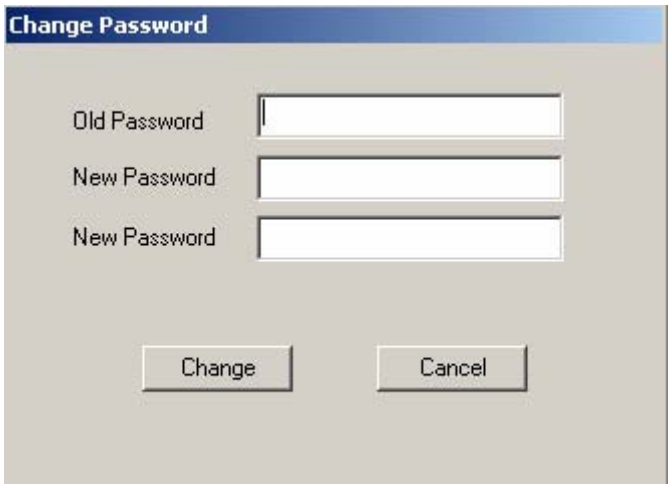

Figure 19: Change Password dialogue box

Procedure 15: Changing Administrator password using the EMS

Use this procedure to change the password from the EMS.

1. Select **File→Change password** from the main menu.
   RESULT: The **Change Password** dialogue box opens (shown in Figure 19).
2. Type the old password, then press Enter or Tab.
3. Type the new password, then press Enter or Tab.
4. Enter the new password again, then press Enter or Tab.
5. To accept, click **Change**.
   To reject, click **Cancel**.

========== **end of procedure** ==========

2.5.3 Select Line Type T1 or E1

Procedure 16: Selecting line type T1 or E1 using the EMS

Follow these steps to configure line coding for the Canopy T1/E1 Multiplexer from the EMS.

NOTE: Selecting either T1 or E1 will configure all 4 channels.

1. From main menu EMS, select the Configuration (**Config**) option.
2. Select **Configure Line Type**.
   RESULT: The Line Config dialogue box opens.
3. Click ↓.
   RESULT: The dropdown list to specify the coding technique T1 channel opens.
4. Click on the appropriate line coding technique for the T1channel being configured.
5. Click on the tab for the next Channel to configure line coding for channel.
6. To configure the line coding technique for each channel, repeat Steps 3 and 4.
7. When all channels are configured, select the **File→Reset** menu option.
   RESULT: A confirmation window pops up.
8. To reset the system, select **Yes**.
9. Select **Close.**
   RESULT: The dialogue box closes and you are returned to the EMS main menu.

end of procedure

2.5.4 Select Line Coding

Procedure 17: Configuring T1 line coding using the EMS

Follow these steps to configure T1 line coding from the EMS.

1. From main menu EMS, select the Configuration (**Config**) option.
2. Select **Configure T1**.
   RESULT: The Config dialogue box opens.
3. Click ↓.
   RESULT: The dropdown list to specify the coding technique T1 channel opens.
4. Click on the appropriate line coding technique for the T1channel being configured.
   NOTE: You must select a coding technique: either B8ZS or AMI.
5. Click on the tab for the next Channel to configure line coding for channel.
   NOTE: If the system has been reset, clicking the **Refresh** button will replace the displayed values with currently-programmed values.
6. To configure the line coding technique for each other channel, repeat Steps 3 and 4.
7. Select **Close** to close the dialogue box once all channels are configured.
   RESULT: You are returned to the EMS main menu.

end of procedure

Procedure 18: Configuring E1 line coding using the EMS

Follow these steps to configure line coding from the EMS.

1. From main menu EMS, select the Configuration (**Config**) option.
2. Select **Configure E1**.
   RESULT: The E1 Config dialogue box opens.
3. Click ↓.
   RESULT: The dropdown list to specify the coding technique E1 channel opens.
4. Click on the appropriate line coding technique for the E1channel being configured.
   NOTE: You must select a coding technique: either **HDB3** or **AMI**.
5. Click on the tab for the next Channel to configure line coding for channel.
   NOTE: If the system has been reset, clicking the **Refresh** button will replace the displayed values with currently-programmed values.
6. To configure the line coding technique for each other channel, repeat Steps 3 and 4.
7. Select **Close** to close the dialogue box once all channels are configured.
   RESULT: You are returned to the EMS main menu.

end of procedure

2.5.5 Configure Ports

Procedure 19: Configuring the Ethernet ports using the EMS

Follow these steps to configure the Ethernet ports using the EMS

1. From the Main Menu, select the pull-down menu **Config→Ethernet.**
   RESULT: The Ethernet Configuration dialogue box opens.
2. Indicate the appropriate choices by clicking on the appropriate radio buttons.
   NOTE: If you select **Auto Negotiation Off**, the Ethernet port will be forced to 100 Mbps full duplex.
3. When the Ethernet configuration is complete, click **OK**.

end of procedure

Procedure 20: Configuring the T1 ports using the EMS

Follow this procedure to configure the T1 ports from the EMS.

1. From the pull-down menu, Select **Config→T1**.
   RESULT: The T1 Config dialogue box opens.
2. Click ↓ for **Length**.
   RESULT: The dropdown list to specify the cable length for the T1 channel opens.
3. Click on the appropriate line length for the T1 being configured.
   NOTE: An improper length can result in decreased line quality or echo.

4. Click ↓ for **Coding**.
5. Select the coding technique for the channel.
   NOTE: For T1, you must select either **B8ZS** or **AMI**.
6. Click on the tab for the next Channel to configure.
   NOTE: If the system has been reset, clicking the **Refresh** button will replace the displayed values with currently-programmed values.
7. Repeat steps 1 and 2 to configure each channel.
8. Click ↓ for **Master Clock Reference Line**.
9. Select which line is to be designated as the master clock line.
10. Click ↓ for **Secondary Clock Reference Line**.
11. Optionally, select which line is to be designated as the backup clock reference line.
12. Click on the radio button to indicate whether the clock source is loopback mode or recovered mode.
    NOTE: The clock source applies to all four T1 channels.

    Loopback mode loops the Tx clock back to the Rx.
    Recovered mode recovers the clock from the incoming T1/E1 over Ethernet-bit-stream (from the far end T1/E1).
13. When all channels are configured, select **Close** to close the dialogue box.
    RESULT: You are returned to the EMS main menu.

end of procedure

Procedure 21: Configuring the E1 ports using the EMS

Follow this procedure to configure the E1 ports from the EMS.

1. From the pull-down menu, Select **Config→E1**.
   RESULT: The E1 Config dialogue box opens.
2. Click ↓ for **Coding**.
3. Select the coding technique for the channel.
   NOTE: For E1, you must select either **HDB3** or **AMI**.
4. Click on the tab for the next Channel to configure.
   NOTE: If the system has been reset, clicking the **Refresh** button will replace the displayed values with currently-programmed values.
5. Repeat steps 1 and 2 to configure each channel.
6. Click ↓ for **Master Clock Reference Line**.
7. Select which line is to be designated as the master clock line.
8. Click ↓ for **Secondary Clock Reference Line**.
9. Optionally, select which line is to be designated as the backup clock reference line.

10. Click on the radio button to indicate whether the clock source is loopback mode or recovered mode.
    NOTE: The clock source applies to all four channels.

    Loopback mode loops the Tx clock back to the Rx.
    Recovered mode recovers the clock from the incoming T1/E1 over Ethernet-bit-stream (from the far end T1/E1).
11. Select **Close** to close the dialogue box once all channels are configured.
    RESULT: You are returned to the EMS main menu.

========== **end of procedure**==========

2.5.6 Configure Timing

Before the timing may be configured, you need to determine the network timing scheme to be used. You also need to identify the master and slave devices for the end-user PBX equipment.

Procedure 22: Configuring timing using the EMS

Use this procedure to configure the timing using the EMS.

1. Select **Config→T1** from the pull-down menu.
   RESULT: The T1 Config dialogue box opens.
2. Click ↓ for Master Clock Reference Line.
3. Select which line is to be designated as the master clock reference line.
4. Click ↓ for **Secondary Clock Reference Line**.
5. Select which line is to be designated as the secondary clock reference line.
6. Click on the radio button to indicate whether the clock source for the T1 unit is loopback mode or recovered mode.
   NOTE: The clock source applies to all four T1 channels.

   Loopback mode loops the T1 Tx clock back to the T1 Rx.
   Recovered mode recovers the T1 clock from the incoming T1 over Ethernet bit-stream (far end T1).

7. When all channels are configured, select **Close**.
   RESULT: You are returned to the EMS main menu.

   NOTE: If the system has been reset, clicking the **Refresh** button will replace the displayed values with currently-programmed values.

========== **end of procedure**==========

3 MANAGING YOUR CANOPY T1/E1 MULTIPLEXERS

3.1 REMOTE MANAGEMENT THROUGH CONTROL PORT

The CONTROL port in the front panel (shown in Figure 6 on Page 14) provides the capability to remotely manage the Canopy T1/E1 Multiplexer. To do so requires an Ethernet to
RS-232 converter. An example of such a converter is available at http://www.precidia.com/products/product1.html.

The configuration for remote management is illustrated in Figure 20.

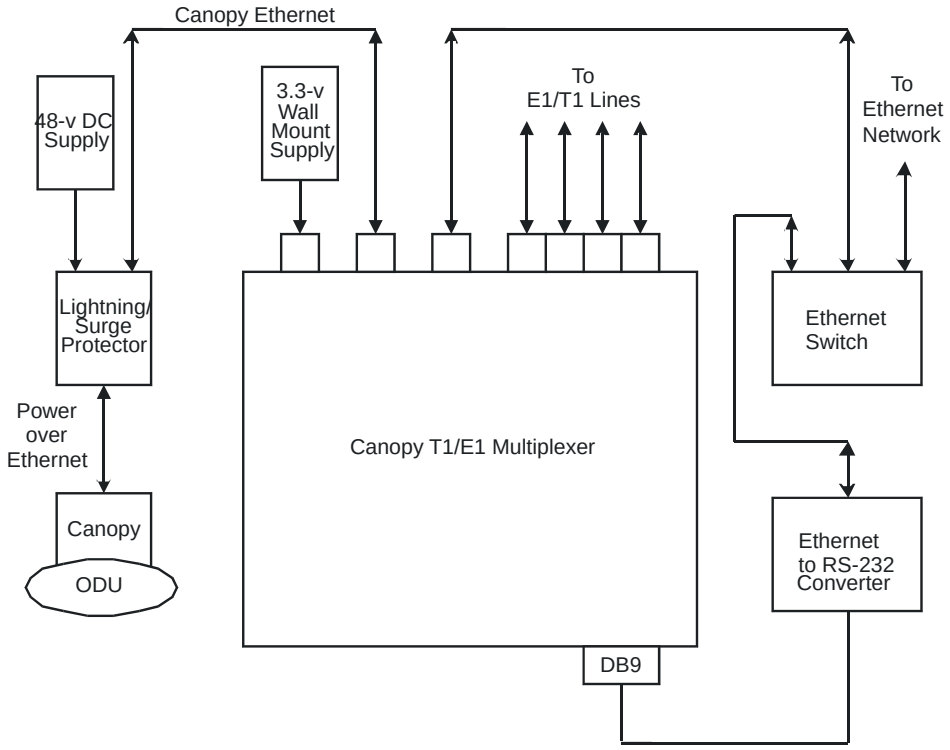

Figure 20: Remote management overview

3.2 T1/E1 ALARMS

Each T1/E1 channel has alarms for line code violation (BPV), receive loss of signal (LOS), and alarm indication signal (AIS) detection.

Follow these steps to display the alarms using the CLI.

Procedure 23: Displaying the alarms using the CLI

Action	Steps
Log in	Press Enter. At the `username` prompt, enter **`admin.`** At the password prompt, enter ***`password`***.

View T1/E1 Alarms	Enter **`get alarms`**.
	
	The system responds displays alarms for all 4 T1/E1 ports, as in the following example:
	
	`Line1:`
	`  Line code violation: No`
	`  Receive Loss of Signal: No`
	`  Alarm Indication Signal Detect: No`
	`Line2:`
	`  Line code violation: No`
	`  Receive Loss of Signal: No`
	`  Alarm Indication Signal  Detect: No`
	`Line3:`
	`  Line code violation: No`
	`  Receive Loss of Signal: No`
	`  Alarm Indication Signal Detect: No`
	`Line4:`
	`  Line code violation: No`
	`  Receive Loss of Signal: No`
	`  Alarm Indication Signal Detect: No`
	`FPGA: 00`

Log off	Enter **`lo`**. ***RESULT:*** The system responds `goodbye`.

========== **end of procedure** ==========

Follow these steps to display the T1/E1 alarms using the EMS.

Procedure 24: Displaying alarms using the EMS

1. Select the **Alarms→T1/E1 Alarms** menu.
   RESULT: The T1/E1 Alarms window pops up as shown in Figure 21.
2. Select the desired T1/E1 Channel (1 through 4).

========== **end of procedure** ==========

NOTES:

1. The T1/E1 alarms will be displayed, with a green light meaning no current alarms and a red light meaning that there is a current alarm. The alarms are also displayed in text form: **No** means that there *is not* a current alarm. **Yes** means that there is a current alarm.
2. The Alarms Log window lists alarms that have occurred for all 4 T1/E1s while the window is open. An alarm log file is automatically written for all 4 T1/E1s. The file exits in the same directory in which the T1/E1 Multiplexer EMS exists. The filename is `apt1AlarmsLog.txt`. The log file can be written only when the T1/E1 Multiplexer EMS is running.

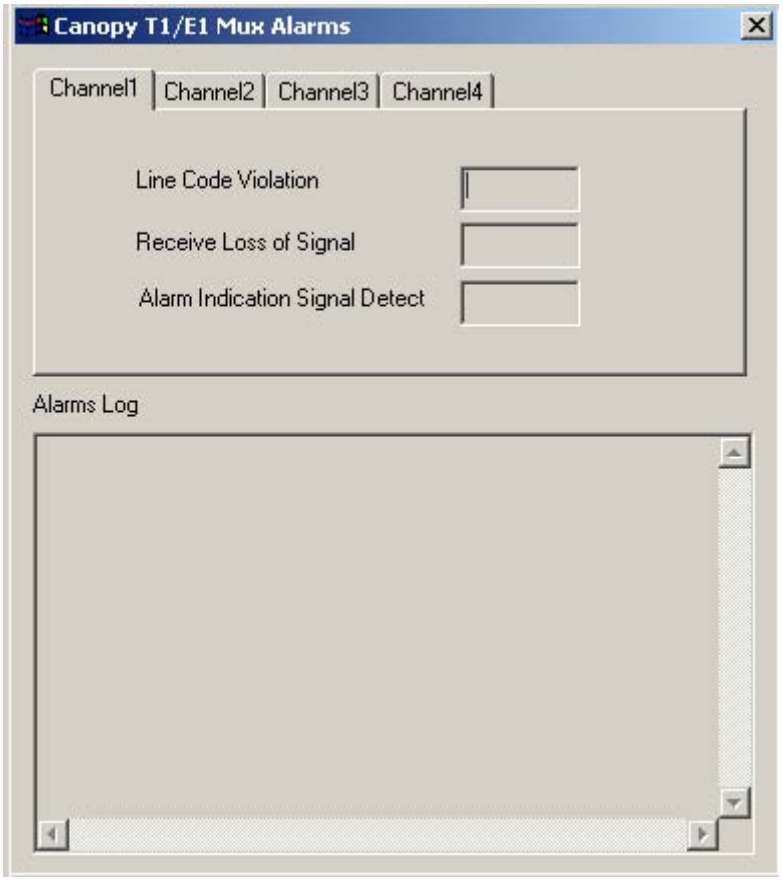

Figure 21: Canopy T1/E1 Mux Alarms window

3.3 SYSTEM RESET

Follow the steps below to reset the system from the CLI.

Procedure 25: Resetting the system using the CLI

Action	Steps
Log in	Press Enter. At the `username` prompt, enter **`admin.`** At the password prompt, enter ***`password`***.
Reset system	Enter **`reset`**. ***RESULT:*** The system responds `Resetting`, then immediately resets both Ethernet Interfaces and all 4 T1/E1 interfaces without asking for a confirmation.

========== **end of procedure** ==========

Follow these steps to reset the system using the EMS.

Procedure 26: Resetting the system using the EMS

1. Select the **File→Reset** menu option.
   RESULT: A confirmation window pops up.
2. To reset the system, select **Yes**.
   NOTE: Selecting **No** cancels the action, and the system will not be reset.

Figure 22: EMS reset confirmation box

========== **end of procedure** ==========

3.4 T1/E1 LOOPBACK

Each of the 4 T1/E1s can be placed in loopback mode for testing and maintenance purposes. This provides a bi-directional loopback on the T1/E1 interface. The near end T1/E1 Transmit is looped back to the near end Receive, and the far end T1/E1 transmit that arrives over the BH Ethernet port is looped back to the far end Receive.

The T1/E1 loopback remains in effect until the user removes the loopback through the CLI or through the EMS, or the system is reset.

CAUTION!
Invoking a T1/E1 Loopback will drop voice calls and disrupt user traffic flow.

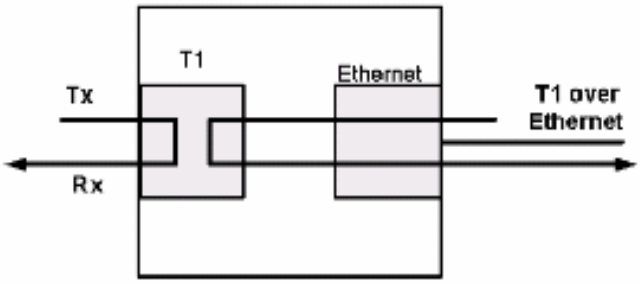

Figure 23: Canopy T1/E1 Multiplexer in T1/E1 Loopback mode

3.4.1 Invoking a T1/E1 Loopback using the CLI

Follow the steps below to invoke a T1/E1 Loopback from the CLI.

Procedure 27: Invoking a T1/E1 loopback using the CLI

Action	Steps
Log in	Press Enter. At the `username` prompt, enter **`admin.`** At the password prompt, enter ***`password`***.
Set T1/E1 into Loopback Mode	Enter set line loopback [1/2/3/4] [on/off] where `[1/2/3/4]` represents T1/E1 ports 1 through 4. `on` will enable T1/E1 loopback. `off` will remove the T1/E1 loopback. The system responds `Line [1/2/3/4] loopback is: [on/off]`
Log off	Enter **`lo`**. ***RESULT:*** The system responds `goodbye`.

========== **end of procedure** ==========

3.4.2 Invoking a T1/E1 Loopback Using the EMS

Procedure 28: Invoking a T1/E1 loopback using the EMS

Use this procedure to invoke a T1/E1 Loopback from the EMS.

1. Select the **Test→Loopback** menu option.
   RESULT: The Loopback Test dialogue box opens.
2. Select the target T1/E1 Channel by clicking on the appropriate tab.
3. Use the **On** or **Off** radio button to invoke or remove the T1/E1 loopback.
   RESULT: The Loopback is immediately invoked or removed.

========== **end of procedure** ==========

3.5 MEASUREMENTS FROM DIAGNOSTICS

A unit-based comparison of diagnostic measurements is provided in Table 13.

Table 13: Comparison of diagnostic measurements

Measurement	Description	Availability	Advantage	Disadvantage
Bit errors	Logic errors in the bit stream	Only out of service	Best unit for point-to-point performance	Requires that all traffic be test traffic (known data pattern)
BPVs	Pulses of the same consecutive polarity	In service or out of service	Good for circuit or repeater problems	Meaningful for only metallic media, because some equipment corrects BPVs
Frame errors	Incorrect values in the framing bit position	In service or out of service	Approximates bit error rate on in-service basis	Evaluates only overhead bits
CRC errors	Bit errors in a block of data	In service or out of service	98.4% bit error rate accuracy	Available with only ESF framing

3.6 FIRMWARE UPGRADES

Firmware upgrades are periodically made available to enhance performance or to add features and functionality to the Canopy T1/E1 Multiplexer.

Procedure 29: Upgrading firmware

To install new firmware on a Canopy T1/E1 Multiplexer, perform the following steps.

1. Close any other applications that are active on the PC.
2. From the main menu of the EMS, select **Config→Software Upgrade** (shown in Figure 15 on Page 33).
   RESULT: The System Upgrade window opens, as shown in Figure 24.

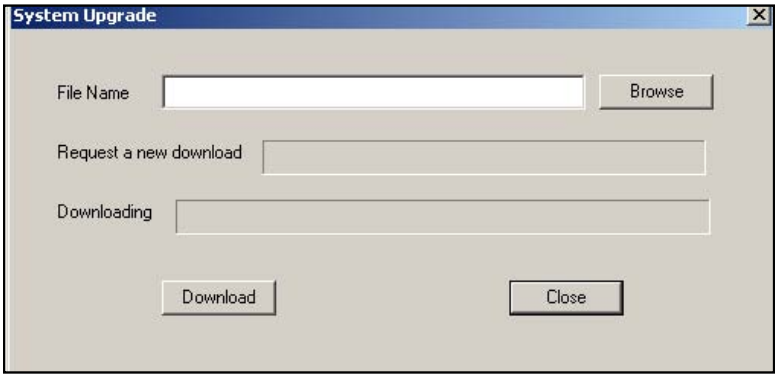

Figure 24: System Upgrade window

3. Click **Browse** to find the new FPGA firmware that your authorized Canopy distributor or reseller provided.
4. Select the file to download.
   NOTE: Typically the filename has the format `Vx_y.bin` (for example, `V3_4.bin`).
5. Click **Download**.
   RESULT: The status bar indicates the progress of the download process.

> ***IMPORTANT!***
> During the download process, *do not* interrupt the download process.

6. Wait until the download is complete.
7. Reset the T1/E1 Multiplexer according to Procedure 26 on 56.
   RESULT: The upgrade process is complete.
8. From the main menu of the EMS, select **Help→About Canopy T1/E1 Mux**.
9. Verify that the intended firmware version is indicated on the screen that results, as shown in Figure 25.

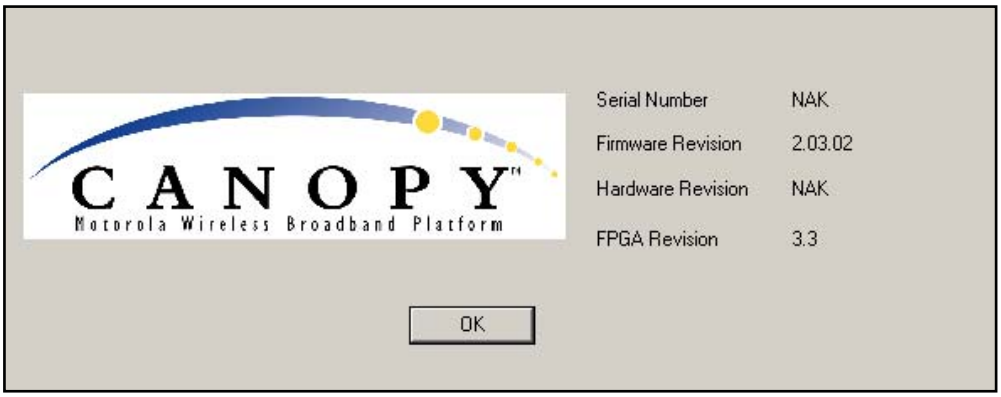

Figure 25: FPGA revision details screen

end of procedure

3.7 LICENSE KEY UPGRADES

As previously described, you can transform any single-port enabled Canopy T1/E1 Multiplexer into a 2-port, 3-port, or 4-port multiplexer through the purchase and installation of license keys from your Canopy distributor.

Procedure 30: Installing a license key to enable an additional port

To install a license key on a Canopy T1/E1 Multiplexer, perform the following steps.

1. From the main menu of the EMS, select **Config→T1/E1 Port Upgrade Config→Software Upgrade** (shown in Figure 15 on Page 33).
   RESULT: The Canopy T1/E1 Port Upgrade window opens, as shown in Figure 26.

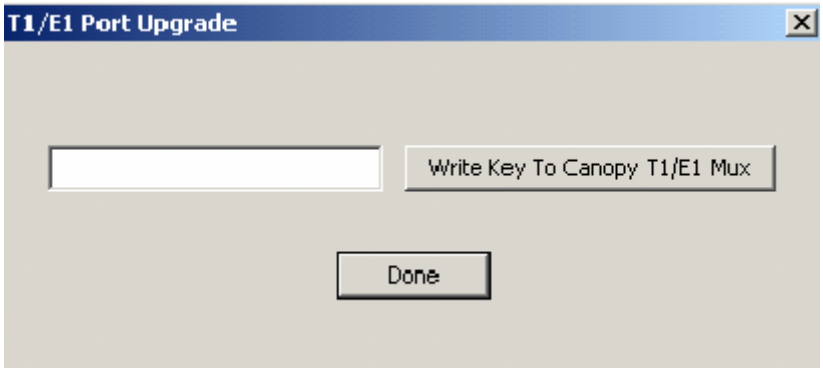

Figure 26: T1/E1 Port Upgrade window

2. Type in the upgrade key that your Canopy distributor provided for this unit, then press Enter.
3. Click **Done**.
   RESULT: If the upgrade succeeded, then the Key accepted window appears (see Figure 27).
   If the upgrade failed, then the Failed: Invalid key entry window appears (see Figure 28).

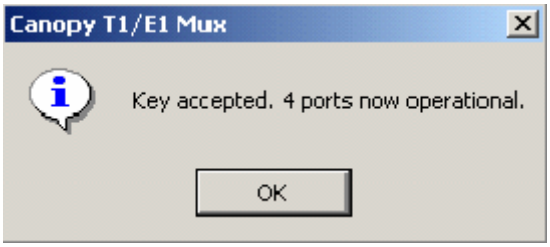

Figure 27: Key accepted window

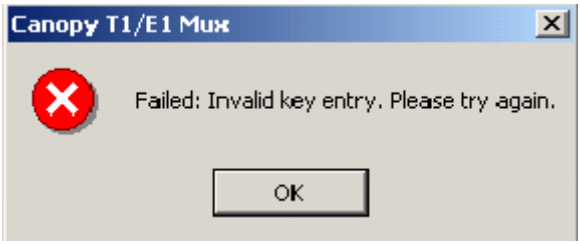

Figure 28: Invalid key entry window

NOTE: At any later date, you can confirm the number of enabled ports as follows.

4. From the main menu, select **Config→Canopy T1/E1 Mux**.
   RESULT: The Canopy T1/E1 Mux Configuration window opens, as shown in Figure 29.

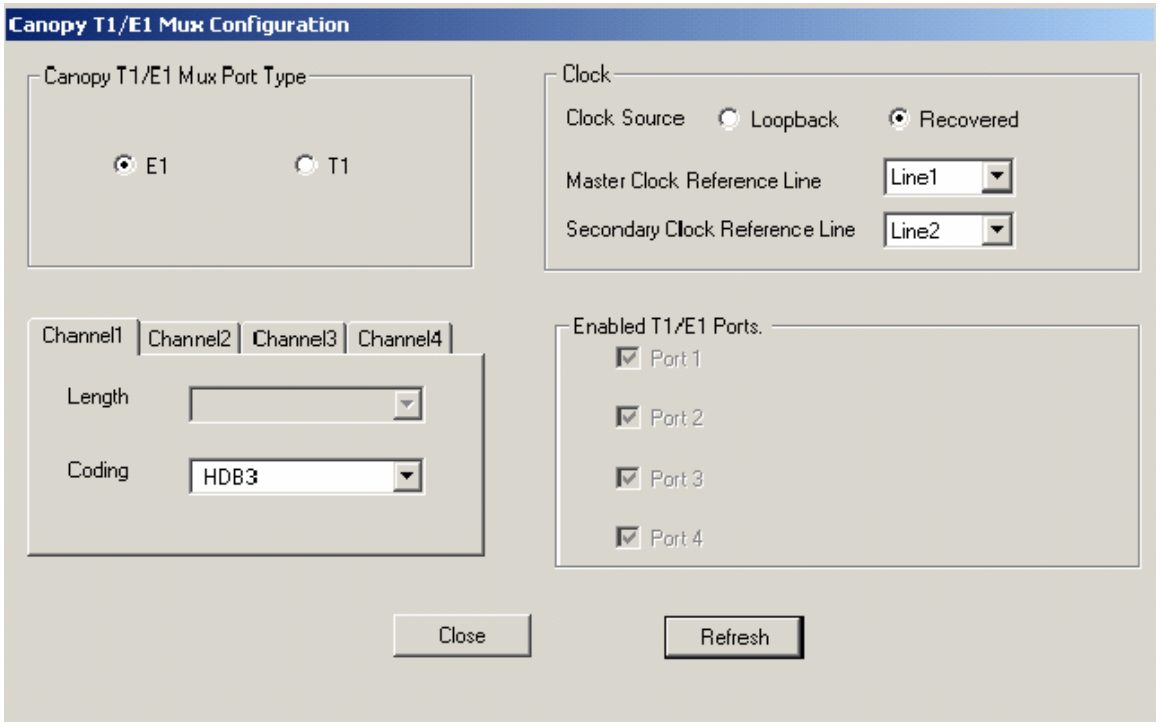

Figure 29: Canopy T1/E1 Mux Configuration window

5. In the lower right quadrant of the window, find the Enabled T1/E1 Ports block.
   NOTE: Each enabled port is identified by a black check mark.

========== **end of procedure** ==========

3.8 TERMS OF WARRANTY

3.8.1 Software License Terms and Conditions

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3.8.2 Hardware Warranty in U.S.

Motorola U.S. offers a warranty covering a period of one year from the date of purchase by the customer. If a product is found defective during the warranty period, Motorola will repair or replace the product with the same or a similar model, which may be a reconditioned unit, without charge for parts or labor.

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3.9 OBTAINING TECHNICAL SUPPORT

To get information or assistance as soon as possible for problems that you encounter, use the following sequence of action:

1. Search this document, the user manuals that support other modules, and the software release notes of supported releases
   a. in the Table of Contents for the topic.
   b. in the Adobe Reader® search capability for keywords that apply.[2]
2. Visit the Canopy systems website at http://www.motorola.com/canopy.
3. Ask your Canopy products supplier to help.
4. View and analyze event logs, error messages, and debug messages to help isolate the problem.
5. Check release notes and verify that all of the Canopy equipment are on the correct software releases per the correct software release notes.

[2] Reader is a registered trademark of Adobe Systems, Incorporated.

6. Verify that the Canopy configuration files match the last known good (baseline) Canopy configuration files captured in site log book.
7. Verify connectivity (physical cabling).
8. At the SM level, minimize your network configuration (remove home network devices to help isolate problem).
9. Perform the site verification checklist.
10. Check FAQs to see whether the problem and a solution are present.
11. Escalate the problem to Canopy systems Technical Support (or another Tier 3 technical support that has been designated for you) as follows:
    a. Compose e-mail to technical-support@canopywireless.com. In this email
        - Describe the problem.
        - Describe the history of the problem.
        - List your attempts to solve the problem.
        - Attach the above files.
        - List the files that you are attaching.
    b. Send the email.
    c. Call 1 888 605 2552 (or +1 217-824-9742).

end of procedure

3.10 INVOKING YOUR WARRANTY RIGHTS

For warranty assistance, contact your reseller or distributor for the process.

4 CANOPY T1/E1 MULTIPLEXER REFERENCE INFORMATION

4.1 CLI COMMANDS TO GET STATUS INFORMATION

Desired Action	Syntax, Response, and Description
Get Canopy-side Ethernet auto-negotiation	Enter **`get canopy port auto negotiation`** The system responds `Canopy port auto-negotiation is: [on/off]` Gets the auto-negotiation mode for the Canopy BH Ethernet port. If auto negotiation is set to OFF, the port will be forced to 100 Mbps Full Duplex.
Get LAN-side Ethernet auto-negotiation	Enter **`get lan port auto negotiation`** The system responds `LAN port auto-negotiation is: [on/off]` Get the auto-negotiation mode for the customer LAN Ethernet port. If auto negotiation is set to OFF, the port will be forced to 100 Mbps Full Duplex.
Get line type	Enter **`get type`** The system responds `Line type [T1/E1]` Gets the line type, either T1 or E1. All four ports have the same line type.

Desired Action	Syntax, Response, and Description
Get T1 line length	Enter **`get line [1/2/3/4] length`** where **`[1/2/3/4]`** represents T1 ports 1 through 4. The system responds `Line [1/2/3/4] length [0-133 / 0.6 dB; 133-266 / 1.2 dB; 266-399 / 1.8 dB; 399-533 / 2.4 dB; 533-655 / 3.0 dB]` Gets the T1 line length. The units are in feet in decibels. If the incorrect line length is selected, the result could be decreased T1 quality or echo on voice lines.
Get T1 line code	Enter **`get code line [1/2/3/4]`** where `[1/2/3/4]` represents T1 ports 1 through 4 The system responds `Line [1/2/3/4] code [B8ZS/AMI]` Gets the T1 line code. If the line code does not match, Bipolar Violations (BPVs) will occur.
Get E1 line code	Enter **`get code line [1/2/3/4]`** where `[1/2/3/4]` represents E1 ports 1 through 4 The system responds: `Line [1/2/3/4] code [HDB3/AMI]` Gets the E1 line code. If the line code does not match, Bipolar Violations (BPVs) will occur.

Desired Action	Syntax, Response, and Description
Get the timing mode	Enter **get clock source** The system responds `Clock source set to [loopback/recovered]` Gets the T1 timing mode. This timing mode applies for all four T1 lines. Loopback mode means to take the T1 Tx clock and loop it back to the T1 Rx. Recovered mode means to recover the T1 clock from the incoming T1 over Ethernet bit stream, in other words to recover the clock from the far end T1.
Get the master clock reference line	Enter **`get master clock reference line`** The system responds `Clk ref line: [1/2/3/4]` ***NOTE:*** `[1/2/3/4]` represents T1/E1 ports 1 through 4. Displays the T1 master clock reference line. This clock reference applies for all four T1 lines.
Get the secondary clock reference line	Enter **`get secondary clock reference line`** The system responds `Backup clk ref line; [1/2/3/4]` ***NOTE:*** `[1/2/3/4]` represents T1/E1 ports 1 through 4. Displays the T1/E1 secondary or backup clock reference line. This clock reference is the backup clock reference for all four T1/E1 lines. The backup clock reference will become active only when the master clock reference line is unavailable.

Desired Action	Syntax, Response, and Description

View T1/E1 Alarms	Enter **`get alarms`**
	
	The system responds displays alarms for all 4 T1/E1 ports, as in the following example:
	
	`Line1:`
	`  Line code violation: No`
	`  Receive Loss of Signal: No`
	`  Alarm Indication Signal Detect: No`
	`Line2:`
	`  Line code violation: No`
	`  Receive Loss of Signal: No`
	`  Alarm Indication Signal  Detect: No`
	`Line3:`
	`  Line code violation: No`
	`  Receive Loss of Signal: No`
	`  Alarm Indication Signal Detect: No`
	`Line4:`
	`  Line code violation: No`
	`  Receive Loss of Signal: No`
	`  Alarm Indication Signal Detect: No`
	`FPGA: 00`

Read Serial Number	Reads the serial number of the Canopy T1/E1 Multiplexer.
Get T1/E1 Loopback Mode	Enter **`get loopback line [1/2/3/4]`** where `[1/2/3/4]` represents T1/E1 ports 1 through 4 The system responds: `Line [1/2/3/4] loopback is: [on/off]` Displays the loopback status of a T1/E1 line.
Get Firmware Revision	Enter **`get firmware revision`** The system responds `Firmware revision is: x.y.z` Gets the revision (version number) of the Canopy T1/E1 firmware.

Desired Action	Syntax, Response, and Description
Get FPGA Revision	Enter **`get fpga revision`** The system responds `FPGA revision is: x.y.z` Get the revision (version number) of the Canopy T1/E1 FPGA. The FPGA controls the T1 parameters.

4.2 REGULATORY COMPLIANCE INFORMATION

This section contains information regarding regulatory compliance with the Federal Communication Commission, Department of Communications and the European Telecommunications Standards Institute applies to the Canopy BH radio link.

4.2.1 Federal Communication Commission Declaration of Conformity Statement

This device complies with Part 15 of FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and radiates radio-frequency energy, and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

WARNING!

The Part 15 radio device operates on a non-interference basis with the other devices operating at this frequency. Any changes or modification to said product not expressly approved by Motorola Canopy could void the user's authority to operate this device.

4.2.2 Department of Communications – Canada

Canadian Compliance Statement

This class B Digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations.

This device complies with RSS-210 of Industry Canada. Operation is subject to the following two conditions: (1) this device can not cause harmful interference; and (2) this device must accept any interference received, including interference that can cause undesired operation.

This device is certified to the requirements of RSS-139. The use of this device in a system operating either partially or completely outdoors can require the user to obtain a license for the system according to Canadian regulations. For further information, contact your local Industry Canada office.

4.2.3 European Telecommunications Standards Institute

Statement of Compliance

Information to User

This equipment has been tested and found to comply with the European Telecommunications Standard ETS 300.328. This standard covers Wideband Data Transmission Systems referred to in CEPT Recommendation T/R 10.01.

This type accepted equipment is designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, can cause harmful interference to radio communications.

4.3 TRADEMARKS, PRODUCT NAMES, AND SERVICE NAMES

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Schaumburg, IL 60196
USA

http://www.motorola.com/canopy

4.4 REFERENCES

This document refers to the following documents:

- American National Standards Institute. ANSI T1.101-1999 – *Telecommunication Synchronization Interface Standards.*
- American National Standards Institute. ANSI T1.105.09-1996 – *Synchronous Optical Network (SONET) Network Element Timing and Synchronization.*
- American National Standards Institute. ANSI T1.403-1989 - *Carrier to customer installation - DS1 metallic interface.*
- Cleveland, Robert F., Jr., David M. Sylvar and Jerry L. Ulcek. Federal Communications Commission, Office of Engineering and Technology. OET Bulletin No. 65. Edition 97-01 (August, 1997). *Evaluation Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields.*
- European Telecommunications Standard ETS 300 328, 2nd Edition, (November, 1996). *Radio Equipment and System (RES); Wideband Transmission Systems; Technical characteristics and test conditions for data transmission equipment operating in the 2,4 GHz ISM band and using spread spectrum modulation techniques.*
- National Electrical Code (NEC), Chapter 800, Article 810, *Radio and Television Equipment.*
- ITU-T Recommendation G.703
- ITU-T Recommendation G.823